THE

POPULAR SCIENCE MONTHLY.

APRIL, 1886.

AN ECONOMIC STUDY OF MEXICO.

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I.

IT is proposed to here ask attention to the results of a recent investigation and study of Mexico, with the intent of exhibiting its economic relations to the United States, and of helping to determine the desirability of the ratification on the part of the latter of a Mexico-American commercial treaty. The basis for this investigation and for such opinions as may be expressed has been: First, a somewhat extended exploration of Mexico, undertaken during the early months of the past year (1885), primarily with a view to health and recreation; and, secondly, a subsequent careful study (prompted by interest in what had been personally seen or heard) of the physical situation and history of the country, and its present political, industrial, and social condition. The journey, it may be further premised, was mainly made upon a special train, over the whole length of the Mexican Central Railroad, over most of the Vera Cruz and City of Mexico and over a part of the Mexican National Railroads; the aggregate distance traversed within the territory of the republic being in excess of three thousand miles, the train running upon its own time, with its own equipment for eating and sleeping, and stopping long enough at every point of interest—city, town, *hacienda*, mine, or desert—to admit of its full and satisfactory exploration. It is safe, therefore, to say that such an opportunity for leisurely visiting and studying so much of Mexico had rarely, if ever, before been granted.*

* The excursion in question was made under the auspices of the Raymond Excursion Company, and was the first of its kind projected and carried out by it.

Although geographically near, and having been in commercial relations with the rest of the world for over three hundred and fifty years, there is probably less known to-day about Mexico than of almost any other country claiming to be civilized; certainly not as much as concerning Egypt, Palestine, or the leading states of British India; and not any more than concerning the outlying provinces of Turkey, the states of Northern Africa, or the seaport districts of China and Japan. It is doubtful, furthermore, if as large a proportion as one in a thousand of the fairly educated men of the United States or of Europe could at once, and without reference to an encyclopædia, locate and name the twenty-seven States or political divisions into which the Republic of Mexico is divided, or so many of its towns and cities as have a population in excess of fifteen or twenty thousand. The explanation of this is that, prior to the construction and opening of the Mexican "Central" and Mexican "National" Railroads, or virtually prior to the year 1883, the exploration of Mexico—owing to the almost total absence of roads and of comfortable *hospicia* for man and beast, the utter insecurity for life and property, the intervention of vast sterile and waterless tracts, and the inhospitality and almost savagery of no small proportion of its people—was so difficult and dangerous that exploration has rarely been attempted; and those who have attempted it have greatly imperiled their lives, to say nothing of their health and property. Mexico, furthermore, is not fully known even to the Mexicans themselves. Thus, a large part of the country on the Pacific coast has scarcely been penetrated outside of the roads or "trails" which lead from the seaports to the interior. There are hundreds of square miles in Southern Mexico, especially in the States of Michoacan and Guerrero, and also in Sonora, that have never been explored; and whole tribes of Indians that have never been brought in contact with the white man, and repel all attempts at visitation or government supervision. During the three hundred years, also, when Mexico was under Spanish dominion, almost access to the country was denied to foreigners; the most noted exception being the case of Humboldt, who, through the personal favor and friendship of Don Marino Urquijo, first Spanish Secretary of State under Charles IV, received privileges never before granted to any traveler; and thus it is that, although more than three quarters of a century have elapsed since Humboldt made his journey and explorations, he is still quoted as the best and, in many particulars, as the only, reliable authority in respect to Mexico.

In 1850, Bayard Taylor, returning from California, visited Mexico, landing at Mazatlan, and crossing the country by way of the city of Mexico to Vera Cruz. His journey lasted from the 5th of January to the 19th of February—a period of about six weeks—and the distance traversed by him in a straight line could not have been much in excess of seven hundred miles—a rather small foundation in the way of

exploration for the construction of a standard work of travel; yet, whoever reads his narrative and enters into sympathy with the author (as who in reading Bayard Taylor does not?) is heartily glad that it is no longer—for Mungo Park in attempting to explore the Niger, or Bruce in seeking for the sources of the Nile, or Livingstone on the Zambesi, never encountered greater perils or chronicled more disagreeable experiences of travel. It was not enough to have "journeyed," as he expresses it, "for leagues in the burning sun, over scorched hills, without water or refreshing verdure, suffering greatly from thirst, until I found a little muddy water at the bottom of a hole"; to have lived on *frijoles* and *tortillas* (the latter so compounded with red pepper that, it is said, neither vultures nor wolves will ever touch a dead Mexican), and to have found an adequate supply of even these at times very difficult to obtain; to sleep without shelter or upon the dirt floors of *adobe* huts, or upon scaffolds of poles, and to have even such scant luxuries impaired by the invasions of hogs, menace of ferocious dogs, and by other enemies "without and within," in the shape of swarms of fleas, mosquitoes, and other vermin; but, in addition to all this, he was robbed, and left bound and helpless in a lonely valley, if not with the expectation, at least with a feeling of complete indifference, on the part of his ruffianly assailants, as to whether he perished by hunger and cold, or effected a chance deliverance. And if any one were to travel to-day over the same route that Bayard Taylor followed, and under the same circumstances of personal exposure, he would undoubtedly be subject to a like experience.

In August, 1878, Hon. John W. Foster, then United States minister to Mexico, writing from the city of Mexico to the Manufacturers' Association of the Northwest, at Chicago, made the following statement concerning the social condition of the country at that time: "Not a single passenger-train leaves this city (Mexico) or Vera Cruz, the (then) termini of the only completed railroad in the country, without being escorted by a company of soldiers to protect it from assault and robbery. The manufacturers of this city, who own factories in the valley within sight of it, in sending out money to pay the weekly wages of their operatives, always accompany it with an armed guard; and it has repeatedly occurred, during the past twelve months (1878), that the street railway-cars from this city to the suburban villages have been seized by bands of robbers and the money of the manufacturers stolen. Every mining company which sends its metal to this city to be coined or shipped abroad always accompanies it by a strong guard of picked men; and the planters and others who send money or valuables out of the city do likewise. The principal highways over which the diligence lines pass are constantly patroled by the armed rural guard or the Federal troops; and yet highway robbery is so common that it is rarely even noticed in the newspapers. One of the commercial indications of the insecurity of communication between

this capital and the other cities of the republic is found in the rate of interior exchange," which at that time, according to the minister, varied from ten per cent in the case of Chihuahua, distant a thousand miles, to two and two and a half per cent for places like Toluca, not farther removed than a hundred miles. Matters are, however, in a much better state at present, and for reasons that will be mentioned hereafter; but the following item of Mexican news, telegraphed from Saltillo (Northern Mexico), under date of February 15, 1885, pretty clearly indicates the scope and desirability for future improvement, and also the present limitation on the authority of the existing national Government: "The commission of officers sent from Zacatecas by the Government to treat for a surrender with the noted bandit leader, Eraclie Bernal, has returned, having been unsuccessful in its mission. The chief demanded the following conditions: Pardon for himself and band, a bonus of thirty thousand dollars for himself, to be allowed to retain an armed escort of twenty-five men, or to be appointed to a position in the army commanding a district in Sinaloa."

How such a statement as the foregoing carries the reader back to the days of the "Robbers of the Rhine," or the "free lances" of the middle ages! With a better government and increased railroad facilities, the amount of travel in Mexico has of late years greatly increased. Before the opening of the Mexican Central, in 1883, the majority of travelers entered the country at the port of Vera Cruz, and journeyed by railroad (opened in 1873) to the capital (two hundred and sixty-three miles), and returned without stopping *en route* in either case; or else made excursions of no great distance from points on our southern frontier into the northern tier of Mexican States—Sonora, Chihuahua, Coahuila, and Tamaulipas—such journeys being usually made on horseback, with preparations for camping out, and also for fighting if it became necessary. Since the opening of the Mexican Central, however, this route offers the greatest facilities for those who desire to reach the city of Mexico, the traveler journeying by a fast train, day and night, the whole route (twelve hundred and twenty-five miles) from El Paso, in the very best of Pullman cars, over a good road, with every accommodation save that of food, which, in spite of the efforts of the company, is and will continue to be bad, simply because the country furnishes few resources—milk selling at some points as high as twenty-five cents a quart and scarce at that, while butter as a product of the country is almost unknown. But, enter Mexico by whatever route, the ordinary traveler has little opportunity to see anything of the country apart from the city of Mexico, save what is afforded by the view from the car-windows, and yet it is from just such experiences that most of the recent books and letters about Mexico have been written.

There is a wonderful depth of truth in a remark attributed to Em-

erson, that "the eye sees only what it brings to itself the power to see"; and the majority of those who in recent years have visited Mexico would seem to have brought to their eyes the power of seeing little else than the picturesque side of things. And of such material there is no lack. In the first place, the country throughout is far more foreign to an American than any country of Europe, except that part of Europe in close proximity to its Asiatic border. Transport a person of tolerably good geographical information, without giving him any intimation as to where he was going, to almost any part of the great plateau of Mexico—outside of the larger cities—and he would at once conclude that he was either at Timbuctoo or some part of the "Holy Land." The majority of the houses are of *adobe* (mud), destitute of all coloration, unless dust-gray is a color, and one story in height. In Palestine, however, and also (according to report) in Timbuctoo, the roofs are "domed"; in Mexico they are flat. The soil is dry, the herbage, when there is any, coarse and somber, and the whole country singularly lacking in trees and verdure. In the fields of the better portions of the country, men may be seen plowing with a crooked stick, and raising water from wells or ditches into irrigating trenches, by exactly the same methods that are in use to-day as they were five thousand years ago or more upon the banks of the Nile. In the villages, women with nut-brown skins, black hair, and large black eyes, walk round in multitudinous folds of cotton fabrics, often colored, the face partially concealed, and gracefully bearing water-jars upon their shoulders—the old familiar Bible picture of our childhood over again, of Rebecca returning from the fountain.

Place a range of irregular, sharp, saw-tooth hills or mountains, upon whose sides neither grass nor shrub has apparently ever grown, in the distance; a cloudless sky and a blazing sun overhead; and in the foreground a few olive-trees, long lines of repellent cacti defining whatever of demarkation may be needed for fields or roadway, and a few donkeys, the type of all that is humble and forlorn—and the picture of village life upon the "plateau" of Mexico is complete.

Would any one recall the "Flight of the Holy Family into Egypt," it is not necessary to visit the galleries of Europe and study the works of the old masters, for here on the dusty plains of Mexico all the scenes and incidents of it are daily repeated: Mary upon a donkey, her head gracefully hooded with a blue *rebozo*, and carrying a young child enveloped on her bosom in her mantle; while Joseph, the husband, bearded and sun-sorched, with naked arms and legs, and sandals on his feet, walks ploddingly by her side, with one hand on the bridle, and, if the other does not grasp a staff, it is because of the scarcity of wood out of which to make one, or because the dull beast stands in constant need of the stimulus of a thong of twisted leather.

Madame Calderon de la Barca, the Scotch wife of one of the first Spanish ministers sent to Mexico after the achievement of her inde-

pendence, and who wrote a very popular book on her travels in Mexico, published in 1843, also notes and thus graphically describes this predominance of the "picturesque" in Mexico:

"One circumstance," she says, "must be observed by all who travel in Mexican territory. There is not one human being or passing object to be seen that is not in itself a picture, or which would not form a good subject for the pencil. The Indian women, with their plaited hair, and little children slung on their backs, their large straw hats, and petticoats of two colors; the long string of *arrieros* with their loaded mules, and swarthy, wild-looking faces; the chance horseman who passes with his *serape* of many colors, his high, ornamental saddle, Mexican hat, silver stirrups, and leather boots—all is picturesque. Salvator Rosa and Hogarth might have traveled here to advantage hand-in-hand; Salvator for the sublime, and Hogarth taking him up where the sublime became ridiculous."

Where Indian blood greatly predominates in the women, the head, neck, shoulders, and legs, to the knee, are generally bare, and their garments little else than a loose-fitting white cotton tunic, and a petticoat of the same material, often of two colors.

At Aguas Calientes, within a hundred yards of the station of the Mexican Central Railroad, men, women, and children, entirely naked, may be seen bathing, in large numbers, at all hours of the day, in a ditch conveying a few feet of tepid water, which flows, with a gentle current, from certain contiguous and remarkably warm springs.

Shoes in Mexico are a foreign innovation, and properly form no part of the national costume. The great majority of the people do not wear shoes at all, and probably never will; but in their place use sandals, composed of a sole of leather, raw-hide, or platted fibers of the maguey-plant, fastened to the foot with strings of the same material, as the only protection for the foot needed in their warm, dry climate. And these sandals are so easily made and repaired, that every Mexican peasant, no matter what may be his other occupation, is always his own shoemaker. As a general rule, also, the infantry regiments of Mexico wear sandals in preference to shoes. Very curiously, the pegged shoes of the United States and other countries are not made and can not be sold in Mexico, as, owing to the extreme dryness of the atmosphere, the wood shrinks to such a degree that the pegs speedily become loose and fall out.

In the country, the so-called *peons*, or agricultural laborers, who comprise nearly all the population, are, as a matter of fact, permanently attached to the soil of the great estates, through conditions respecting the obligation of debts that practically amount to slavery; and it is claimed that the keeping of the peons constantly in debt—a matter not difficult to accomplish by reason of their ignorance and improvidence—and so making permanent residence and the performance of labor obligatory on them—is indispensable for the regular

prosecution of agriculture; inasmuch as the peon, if free, can never be depended upon, if he gets a few dollars or shillings in his pocket, and there is a place for him to gamble within from fifty to one hundred miles' distance. It is to be noted, however, that, wherever Mexico comes in contact with the outside world, the peon system tends to decay; and in the northern States of Mexico, where American ideas are finding their way among the people, and the construction of railways has increased the opportunities for employment, and raised wages, it is already practically abandoned. On each estate, or *hacienda*, there are buildings, or collections of buildings, typical of the country, borrowed originally, so far as the idea was concerned, in part undoubtedly from Old Spain, and in part prompted by the necessities for defense from attack under which the country has been occupied and settled, which are also called *haciendas*, the term being apparently used indifferently to designate both a large landed estate, as well as the buildings, which, like the old feudal castles, represent the ownership and the center of operations on the estate. They are usually huge rectangular structures—walls or buildings—of stone or adobe, intended often to serve the purpose, if needs be, of actual fortresses, and completely inclosing an inner square, or court-yard, the entrance to which is through one or more massive gates, which, when closed at night, are rarely opened until morning. Within the court, upon one side, built up against an exterior wall, is usually a series of adobe structures—low, windowless, single apartments—where the peons and their families, with their dogs and pigs, live; while upon the other sides are larger structures for the use or residence of the owner and his family, or the superintendent of the estate; with generally also a chapel and accommodations for the priest, places for the storage of produce, and the keeping of animals; and one or more apartments entirely destitute of furniture or of any means of lighting or ventilation, save through the entrance or doorway from the court-yard, which are devoted to the reception of such travelers as may demand and receive hospitality to the extent of shelter from the night, or protection from outside marauders. Such places hardly deserve the name of inns, but either these poor accommodations or camping out is the traveler's only alternative. They put one in mind of the caravansaries of the East, or better of the inns or *posadas* of Spain, which Don Quixote and his attendant Sancho Panza frequented, with the court-yard then, as now, all ready for tossing Sancho in a blanket in presence of the whole population. In some cases the *hacienda* is an irregular pile of adobe buildings without symmetry, order, or convenience; and in others, where the estate is large and the laborers numerous (as is often the case), only the most important buildings are inclosed within the wall—the peons, whose poverty is generally a sufficient safeguard against robbery, living outside and constituting a scattered village community. The owners of the large Mexican estates rarely live upon them, but make their homes

in the city of Mexico or in Europe, and intrust the management of their property to a superintendent, who, like the owner, considers himself a gentleman, and whose chief business is to keep the peons in debt, or, what is substantially the same thing, in slavery. Whatever work is done is performed by the peons—in whose veins Indian blood predominates—in their own way and in their own time. They have but few tools, and, except possibly some contrivances for raising water, nothing worthy the name of machinery. Without being bred to any mechanical profession, the peons make and repair nearly every implement or tool that is used upon the estate, and this too without the use of a forge or of iron, not even of bolts and nails. The explanation of such an apparently marvelous result is to be found in a single word, or rather material, raw-hide, with which the peon feels himself qualified to meet almost any constructive emergency, from the framing of a house to the making of a loom, the mending of a gun, or the repair of a broken leg; and yet even under these circumstances the great Mexican estates, owing to their exemption from taxation, and the cheapness of labor, are said to be profitable, and, in cases where a fair supply of water is obtainable, to even return large incomes to their absentee owners.

In no truly Mexican house of high or low degree, from the adobe hut of the peasant to the stone palace erected by the Emperor Iturbide, are there any arrangements for warming or, in the American sense, for cooking; and in the entire city of Mexico, with an estimated population of from 225,000 to 500,000, chimneys, fireplaces, and stoves are so rare that it is commonly said that there are none. This latter statement is, however, not strictly correct; yet it approximates so closely to the truth that, but for provision for warm baths, there is probably no exception to it in any of the larger hotels of the city where foreigners most do congregate. Apart from the capital and some of the larger cities, Mexico is noticeably deficient in hotels or inns for the accommodation of travelers, and in a majority of the smaller towns there are no such places. And why should there be? The natives rarely go anywhere, and consequently do not expect anybody to come to them.

Large, costly, and often elegant stone edifices—public and private—are not wanting in the principal towns and cities of Mexico; but all, save those of very recent construction, have the characteristic Saracenic or Moorish architecture of Southern Spain—namely, a rectangular structure with rooms opening on to interior piazzas, and a more or less spacious court-yard, which is often fancifully paved and ornamented with fountains and shrubbery; while the exterior, with its gate-furnished archways and narrow and iron-grated windows, suggests the idea of a desire for jealous seclusion on the part of the inmates, or fear of possible outside attack and disturbance. Wooden buildings are almost unknown in Mexico, and in all interiors wood is

rarely used where stone, tiles, and iron are possible applications. Consequently, and, in view of the scarcity of water, most fortunately, there are few fires in Mexico; no fire departments, and but little opportunity for insurance companies or the business of insurance agents. As a general rule, the buildings of Mexico, exclusive of the huts, in which the masses of the people live, are not over one story in height, flat-roofed, and have neither cellars nor garrets; and in buildings of more than one story the upper floor is always preferred as a dwelling, and thus in the cities commands the highest rents. There do not, moreover, seem to be any aristocratic streets or quarters in the cities of Mexico; but rich and poor distribute themselves indiscriminately, and not unfrequently live under the same roof.

The popular opinion concerning Mexico is that it is a country of marvelous and unbounded natural resources. Every geography invites attention to the admirable location of its territory, between and in close proximity to the two great oceans; to the great variety, abundance, and richness of its tropical products—sugar, coffee, tobacco, dye and ornamental woods, vanilla, indigo, cacao, cochineal, fruits, fibers, and the like; and to the number of its mines, which for more than two centuries have furnished the world with its chief supply of silver, and are still productive. The result is, that with a majority of well-informed people, and more especially with those who have read about Mexico in those charming romances of Prescott, and who, in flying visits to its capital, have found so much to interest them in the way of the picturesque, and have brought to their eyes little capacity for seeing anything else, the tendency has been to confound the possible with the actual, and to encourage the idea that Mexico is a rich prize, unappreciated by its present possessors, and only waiting for the enterprising and audacious Yankees to possess and make much of, by simply coming down and appropriating.

Now, with these current beliefs and impressions the writer has little sympathy; but, on the contrary, his study and observations lead him to the conclusion that the Mexico of to-day, through conjoined natural and artificial (or human) influences, is one of the very poorest and most wretched of all countries; and, while undoubtedly capable of very great improvement over her present condition, is not speedily or even ultimately likely, under any circumstances, to develop into a great (in the sense of highly civilized), rich, and powerful nation. And in warrant and vindication of opinions so antagonistic to popular sentiment, it is proposed to ask attention to a brief review of the condition of Mexico; *first*, from its geographical or natural stand-point, and *secondly*, from the stand-point of its historical, social, and political experience.

Considered geographically, Mexico is, in the main, an immense table-land or plateau, which seems to be a flattening out of the Rocky

and Sierra Nevada Mountains, and which, commencing within the territory of the United States as far north certainly as Central Colorado, and perhaps beyond, extends as far south as the Isthmus of Tehuantepec; a north and south length, measuring from the southern frontier-line of the United States, of about two thousand miles. Entering the country by the Mexican Central Railway at El Paso, where the plateau has already an elevation of 3,717 feet, the traveler progressively and rapidly ascends, though so gradually that, except for a *détour*, made obligatory in the construction of the road to climb up into the city of Zacatecas, he is hardly conscious of it until, at a point known as Marquez, 1,148 miles from the starting-point and 76 miles from the city of Mexico, the railroad-track attains an elevation of 8,134 feet, or 1,849 feet higher than the summit of Mount Washington. From this point the line descends 834 feet into the valley of the city of Mexico, the bottom of which is about 7,300 feet above the sea-level. In fact, as Humboldt as far back as 1803 pointed out, so regular is the great plateau on the line followed by the Central road, and so gentle are its surface slopes where depressions occur, that the journey from the city of Mexico to Santa Fé, in New Mexico, might be performed in a four-wheeled vehicle.

Starting next from the city of Mexico, and going east toward the Atlantic, or west toward the Pacific, for a distance in either direction of about one hundred and sixty miles, and we come to the edge or terminus of this great plateau; so well defined and so abrupt that in places it seems as if a single vigorous jump would land the experimenter, or all that was left of him, at from two to three thousand feet lower level. Up the side of this almost precipice—tunneling through or winding round a succession of mountain promontories—the Vera Cruz and City of Mexico Railroad has been constructed; "rising" or "falling"—according to the direction traveled—over four thousand feet, in passing over a circuitous track of about twenty-five miles; and of which elevation or depression about twenty-five hundred perpendicular feet are comprised within the first thirteen miles, measured from the point where the descent from the edge of the plateau begins. To overcome this tremendous grade in ascending, a sort of double locomotive—comprising two sets of driving machinery, with the boilers in the center, and known as the "Farlie" engine—is employed; and even with this most powerful tractor it is necessary, with an ordinary train, to stop every eight or ten miles, in order to keep up a sufficient head of steam to overcome the resistance. In descending, on the other hand, only sufficient steam is necessary to work the brakes and counteract the tendency to a too rapid movement. As an achievement in engineering the road has probably no parallel, except it may be in some of the more recent and limited constructions among the passes of Colorado; and, as might be expected, the cost of transportation over the entire distance of 263 miles, from Vera Cruz to the city of

Mexico, is very heavy, although at an enormous reduction on the cost of all methods previously employed. When the road was first opened, the charges for first-class freight per ton were $76; second class, $65; and by passenger-trains, $97.77. Since the opening of, and under the influence of the competition of, the Mexican Central, these rates have been reduced to an average of about $40 to $45 per ton, and still the business is understood to be not especially remunerative. Begun in 1857, this road was not completed, owing mainly to the disturbed state of the country, until 1873. It was built under English supervision, and with English capital, at a cost, including equipment, of $39,000,000, and is solid and excellent throughout. During the year 1876 the road was destroyed at different points by the revolutionists, and all traffic for a considerable time suspended.

At the station "Esperanza," one hundred and fifty miles from the city of Mexico, on the farther side of a great sandy plain, and on the very verge of the plateau, and where the descent may be said to abruptly begin, the stations, engine-houses, and shops, built of dressed stone, are as massive and elegant as any of the best suburban stations on any of the British railways. And as illustrating how rigidly the English engineers adhered to home rules and precedents, the constructions at this station include a very elegant and expensive arched bridge of dressed stone, with easy and extended approaches, to guard against danger in crossing the tracks; although, apart from the persons in the employ of the company, the resident population is very inconsiderable.

Starting from this point in the early morning of the 27th of March, to make the descent to the comparatively level and low land intervening between the base of the plateau and the ocean, the ground at the station was white with hoar-frost, while behind it, apparently but a mile or two distant, and of not more than fifteen hundred to two thousand feet in elevation, rose the glistening, snow-covered cone of Orizaba. Within the cars, and even with closed windows, overcoats and shawls were essential. Within an hour, however, overcoats and shawls were discarded as uncomfortable. Within another hour the inclination was to get rid of every superfluous garment, while before noon the thermometers in the cars ranged from 90° to 95° Fahr., and the traveler found himself in the heart of the tropics, amid palms, orange-trees, coffee-plantations, fields of sugar-cane and bananas, almost naked Indians, and their picturesque though miserable huts of cane or stakes, plastered with mud and roofed with plantain-leaves or corn-stalks. In the descent, Orizaba (17,373 feet), which at the starting-point, and seen from an elevation of about 8,000 feet, is not impressive in respect to height, although beautiful, gradually rises, and finally, when seen from the level of the low or coast lands, becomes a most magnificent spectacle, far superior to Popocatepetl, which is higher, or any other Mexican mountain, but, in the opinion of the writer, in-

ferior in sublimity to Tacoma in Washington Territory, the entire elevation of which last (14,300 feet) can, in some places, be taken in at a single glance from the sea-level and a water-foreground. The comparatively narrow and gently sloping strip of land which the traveler thus reaches on the Atlantic side in journeying from Mexico to Vera Cruz extends from the base of the great plateau to the ocean, and, with its counterpart on the Pacific side, constitutes in the main the so-called "*Tierras Calientes*" (hot lands), or the tropical part of Mexico. The average width of these coast-lands on the Atlantic is about sixty miles, while on the Pacific it varies from forty to seventy miles.

Considered as a whole, the geographical configuration and position of Mexico have been compared to an immense cornucopia, with its mouth turned toward the United States and its concave side on the Atlantic; having an extreme length of about 2,000 miles, and a varying width of from 1,000 to 130 miles. Its territorial area is 761,791 square miles, or a little larger than that part of the United States, east of the Mississippi River, exclusive of the States of Wisconsin and Mississippi; and this cornucopia in turn, as has been before intimated, consists of an immense table-land, nine tenths of which have an average elevation of from 5,000 to 7,000 feet. Such an elevation in the latitude of 42° (Boston or New York) would have given the country an almost Arctic character; but under the Tropic of Cancer, or in latitudes 18° to 25° north, the climate at these high elevations is almost that of perpetual spring. At these high elevations of the Mexican plateau furthermore, the atmosphere is so lacking in moisture, that meat, bread, or cheese, never molds or putrefies, but only spoils by drying up. Perspiration, even when walking briskly in the middle of the day, does not gather or remain upon the forehead or other exposed portions of the body; and it is only through this peculiarity of the atmosphere that the city of Mexico, with its large population, and its soil reeking with filth through lack of any good and sufficient drainage, has not long ago been desolated with pestilence. As it is, the death-rate of the city is reported to be larger than at almost any of the great centers of the world's population from which sanitary science has been enabled to obtain data.

The surface of this great Mexican plateau, or table-land, although embracing extensive areas of comparatively level surface, which are often deserts, is nevertheless largely broken up by ranges of mountains, or detached peaks—some of which, like Popocatepetl, Orizaba, and Toluca, rise to great elevations—a circumstance which it is important to remember, and will be again referred to, in considering the possible future material development of the country.

Again, if we except certain navigable channels which make up for short distances from the sea into the low, narrow strips of coast-lands, there is not a navigable river in all Mexico; or, indeed, any stream,

south of the Rio Grande, that in the United States, east of the Mississippi, would be regarded as of any special importance. In respect, therefore, to this element of commercial prosperity, Mexico has been characterized as less favored than any considerable country except Arabia; the name of which last, as is well known, stands almost as a synonym for aridity.

No one accurately knows the actual population of Mexico, as no accurate census has ever been taken; and there is no immediate prospect that any will be: certainly not so long as a majority of the people have a fear of giving any information in respect to their numbers, as is represented, and a not inconsiderable part of the country, as has already been pointed out, has never yet been brought under the rule of civil authority. The estimate is, however, from ten to twelve million; and of this number, fully nine tenths are believed to be located upon the high or table lands, and only one tenth on the lowlands of the east and west coasts.

So much, then, for Mexico, considered geographically or in respect to its natural conditions. Let us next, as a means of better comprehending its present condition, briefly consider its historical, social, and political experiences.

The authentic history of Mexico practically commences with its conquest and occupation by the Spaniards under Cortes in 1521. The general idea is, that the people whom the Spaniards found in Mexico had attained to a degree of civilization that raised them far above the level of the average Indians of North America, more especially in all that pertained to government, architecture, agriculture, manufactures, and the useful arts, and the production and accumulation of property. For all this there is certainly but very little foundation, and the fascinating narrations of Prescott, which have done so much to make what is popularly considered "Mexican history," as well as the Spanish chronicles from which Prescott drew his so-called historic data, are, in the opinion of the writer, and with the exception of the military record of the Spaniards, little other than the merest romance, not much more worthy, in fact, of respect and credence than the equally fascinating stories of "Sinbad the Sailor." And, in defense and warrant for such an unusual and perhaps unpopular conclusion, attention is asked to the following circumstances and reasons:

In the Museum of the city of Mexico, there is probably the best collection of the remains of the so-called Aztec people that ever has, or probably ever will be gathered. Here, ranged upon shelves and properly classified, the visitor will see a large number and variety of their tools, weapons, and implements. Setting aside their fictile or pottery products, they are all of stone—the same arrow-heads, the same stone hatchets, pestles, and the like, which are still picked up on the fields and along the water-courses of New England, the South, and the West; and of which there are so many public and private collections in the

United States—no better than, and in some respects inferior in artistic merit and finish to, many like articles excavated from the Western mounds, or known to have been the work of our historic Indians; or to the arrow-heads and lance-tips which are still fabricated by the Shoshones and Flatheads on the Columbia and Snake Rivers. In all this large Aztec collection there is not a single metal tool or fabrication, and in only a very few instances have any such articles of unquestionable antique origin ever been found in Mexico. And of the pottery and stone-work in the shape of idols, small and big, masks, and vases, and of which there are many specimens in the museum and throughout the country, it is sufficient to say that it is all of the rudest kind, and derives its chief attraction and interest from its hideousness and almost entire lack of anything which indicates either artistic taste or skill on the part of its fabricators. Take any fair collection of what purports to be the products of Aztec skill and workmanship, and place the same side by side with a similar collection made in any of the most civilized of the islands of the Pacific—the Feejees, the Marquesas, or the Sandwich Islands, or from the tribes that live on Vancouver's Sound, and the superiority of the latter would be at once most evident and unquestionable. In all fairness, therefore, all controversy with the writer's position, if there is any, ought to be considered as settled; for there is no more infallible test and criterion of the civilization and social condition of either a man or a nation than the tools which he or it works with; and stone hatchets and stone arrow-heads are the accompaniments of the stone age and all that pertains thereto, and their use is not compatible with any high degree of civilization or social refinement. But this is not all. It is now generally conceded that the Aztec tribes, that have become famed in history, did not number as many as two hundred and fifty thousand, and that the area of territory to which their rule was mainly confined did not much exceed in area the State of Rhode Island. The first sight of a horse threw them into a panic, and they had no cattle, sheep, swine, dogs, or other domestic animals—save the turkey—of any account. They had no written language, unless the term can be properly applied to rude drawings of a kind similar to those with which the North American Indian ornaments his skin or scratches upon the rocks. It is very doubtful if they had anything which could be regarded as money, and in the absence of beasts of burden, of any system of roads and of wheeled vehicles, or, indeed, of any methods of transportation other than through the muscular power and backs of men, they could have had but little internal trade or commerce. Prescott assigns to the Aztec city of Mexico a population of three hundred thousand, and sixty thousand houses, and abundant fountains and reservoirs of water; but a very brief reflection would seem to make it evident that no such population could have been regularly supported, mainly with bulky agricultural food trans-

ported on the backs of men, or in light canoes through canals from the neighboring small salt lakes ; or supplied with water sufficient for fountains, drinking, and domestic purposes, through an earthen pipe "of the size of a man's body," brought some miles "from Chapultepec ;" the water adjacent to the city being then, as now, salt and unfit for use. What their manufactures could have been, with stone tools and the most primitive machinery, it is not difficult to conjecture. Probably not materially different from what the traveler may yet see at the present day in the case of the Indian woman, who seated by the wayside, with a bundle of wool under her arm and a spindle consisting of a stem of wood, one end resting in a cup formed from the shell of a gourd, dexterously and rapidly draws out and spins a coarse, but not uneven thread. What their architecture was may be inferred from the circumstance that Cortes, with his little band of less than five hundred Spaniards, leveled to the ground three quarters of the city of Tenochtitlan in the seventeen days of his siege ; while of the old city of Mexico, with its reported palaces and temples, there is absolutely nothing left which is indicative of having formed a part of any grand or permanent structure.

That there was, antecedent to the Aztecs, in this country of Mexico and Central America, a superior race to which the name of Toltecs or Mayas has been applied, who built the elaborate stone structures of Yucatan and of other portions of Central America, and who, it would seem, must have been acquainted with the use of metals, can not be doubted. At a town called Tula, about fifty miles from Mexico, on the line of the Mexican Central, where the Toltecs are reported to have first settled, the traveler will see on the plaza, the lower half—i. e., from the feet to the waist—of two colossal and rude, sitting figures ; also, several perfect cylindrical sections of columns, which were very curiously arranged to fit into and support each other by means of a tenon and mortise, all of stone. The material of which these objects of unquestionably great antiquity are composed, and which all archæologists who have seen them agree are not Mexican or Aztec in their origin, is a very peculiar black basalt, so hard that a steel tool hardly makes an impression upon it. When the same traveler arrives in the city of Mexico, and is shown the three greatest archæological treasures of American origin—namely, the great idol, "Huitzilopochtli," the "Sacrificial Stone," and the so-called "Calendar" stone, now built into one of the outer walls of the cathedral—he might remark that the material of which they are all constructed is the same hard, black stone which constitutes the relics at Tula, and that neither in the large collections of the Museum of Mexico, nor anywhere else, are there any articles, of assumed Aztec origin, composed of like material. Hence an apparently legitimate inference that the latter have a common origin with the constructions at Tula, and are relics of the Toltecs or older nations, and not of the Aztecs.

Again, while much speculation has been had in respect to the origin and use of the mounds of our Western and Southwestern States, it seems to have been overlooked that almost the exact counterparts of these mounds exist to-day in the earth-pyramid of Cholula, near Puebla, and the two pyramids of Teotihuacan, about fifty miles east of the city of Mexico; and that those structures were in use for religious rites and purposes—i. e., "mound-worship"—at the time of the invasion of the country by the Spaniards under Cortes. It seems difficult, therefore, to avoid also this further inference, that there is an intimate connection as to origin and use between all these North American mound-structures, and that they are all the work of substantially one and the same people, who found their last development and, perhaps, origin in Mexico or Central America. In calling attention to these circumstances, and in venturing opinions concerning them, the writer makes no pretension to archæological knowledge, but he simply offers what seem to him the simple, common-sense conclusions which every observer must come to, who does not bring to his eye a capacity for seeing what has been limited by some preconceived theories.

EXTERNAL FORM OF THE MAN-LIKE APES.*

By ROBERT HARTMANN,
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IN the gorilla, the chimpanzee, and the orang-outang the external form is subject to essential modifications, according to the age and sex. The difference between the sexes is most strongly marked in the gorilla, and these differences are least apparent in the gibbon.

When a young male gorilla is compared with an aged animal of the same species, we are almost tempted to believe that we have to do with two entirely different creatures. While the young male still displays an evident approximation to the human structure, and develops in its bodily habits the same qualities which generally characterize the short-tailed apes of the Old World, with the exception of the baboon, the aged male is otherwise formed. In the latter case the points of resemblance to the human type are far fewer; the aged animal has become a gigantic ape, retaining indeed in the structure of his hands and feet the characteristics of the primates, while the protruding head is something between the muzzle of the baboon, the bear, and the boar. Simultaneously with these remarkable alterations of the external structure there occurs a modification of the skeleton. The skull of an aged male gorilla becomes more prognathous, and the incisor teeth have

* From Anthropoid Apes. By Robert Hartmann. With Sixty-three Illustrations. No. 51, International Scientific Series. New York: D. Appleton & Co., 1886.

almost attained the length of those of lions and tigers. On the upper part of the skull, which is rounded in youth, great bony crests are developed on the crown of the head and on the occiput, and these are supported by the high, spinous processes of the cervical vertebræ, and thus supply the starting-point for the powerful muscles of the neck and jaw. The supraorbital arches are covered with wrinkled skin, and the already savage and indeed revolting appearance of the old gorilla is thereby increased. A comparison of the two illustrations (Figs. 1 and 3) which accompany the text will make this clear.

These distinctions are not so striking in the female as in the male gorilla. Although there is much which is bestial in the appearance of an aged female, yet the crests, so strongly marked in the male, the projecting orbits, and strong muscular pads are absent in the female, as well as the prognathous form of the skull and the length and thickness of the canine teeth. The aged female gorilla is not, in her whole structure, so far removed from the condition of the same sex in youth as is the aged male. The structure of the female has on the whole more in common with the human form. It has been said, and indeed on good authority, that the female type should take the foremost place in the study of the animal structure, since it is the more universal. But H. von Nathusius maintains that we must take both sexes into consideration in the study of domestic animals, since both are needed to determine the breed.* I accept this condition in the scientific study and description of wild animals also, of every kind and species. All that is said of the universal type of the female animal is and must remain in my eyes a mere phrase. Only the accurate observation of males and females, and of young individuals of both sexes, can throw sufficient light on the history of the race. The male animal is the larger, and predominant with respect to the complete development of certain peculiarities of form in the specific organism, since these are doubtfully present in the adult female, and are either altogether absent in the immature young, or only rudimentary.

Let us now consider, in the first place, the prototype of the species, the aged male gorilla in the full strength of his bodily development (Fig. 1). This animal, when standing upright, is more than six feet in height, or two thousand millimetres. The head is three hundred millimetres in length. The occiput appears to be broader below than above, since the upper part slopes like a gabled roof toward the high, longitudinal crest of the vertex. The projecting supraorbital arches start prominently from the upper and central contour of the skull. In this species, as in other apes, and indeed among mammals generally, and especially in the case of the carnivora, ruminants, and multi-ungulates, eyebrows are present. In the gorilla these consist of a rather scanty growth of coal-black bristles, about forty millimetres in length. Beneath the projecting supraorbital arches are the eyes, opening with

* "Vorträge über Viehzucht und Rassenkenntniss," vol. i, p. 61. Berlin, 1872.

somewhat narrow slits, and with lids which display many and deep longitudinal folds. The upper lid is set with longer and thicker eyelashes than the lower. The dark eyes glow between the lids with a ferocious expression.

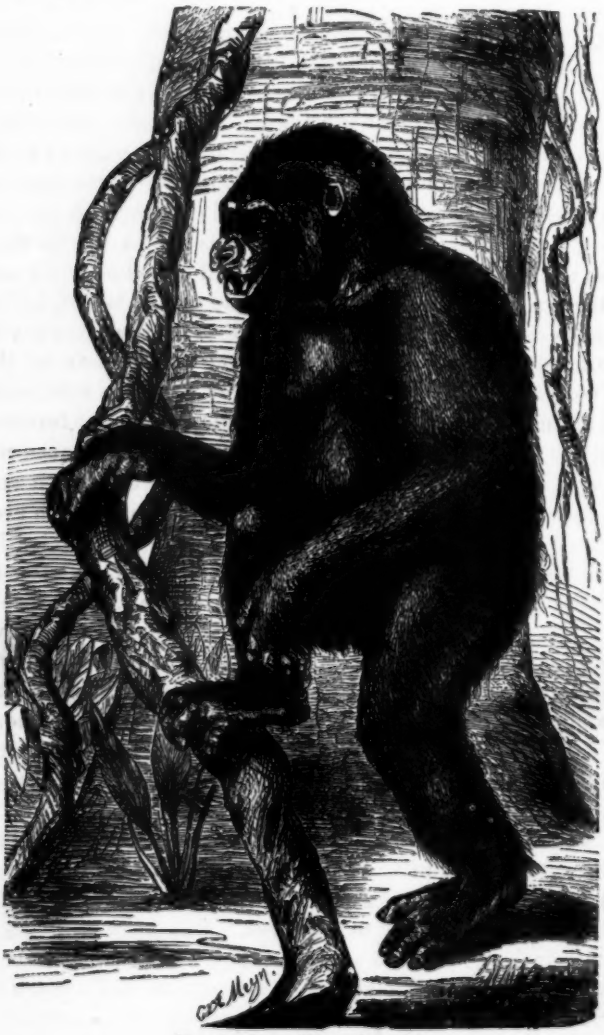

FIG. 1.—AGED MALE GORILLA.

The bridge of the nose rises gradually outward, from between the inner corners of the eyes, and is keel-shaped in the center. This part of the head is from seventy to eighty millimetres in length, longer and narrower in one individual, shorter and wider in another. The skin in this region is covered with a net-work of wrinkles of varying size. The end of the nose and the nostrils are high, conical, and very wide

at the base. This part of the nose, attached to the very projecting forehead, has the effect of an altogether snout-like muzzle. It is intersected by a central longitudinal furrow, which divides the whole tip of the nose into two symmetrical halves. This furrow is more strongly marked in the case of adult animals than in the young. The aperture of the nostrils is large and triangular, with the cartilaginous point turned upward, and the edges applied to the bridge of the nose and to the cheeks have a somewhat retreating appearance. The lateral margins of this part of the nostril take an arched form, first diverging in different directions, then gradually converging again toward the upper lip. The lip is short, and this, combined with the large nose, gives a certain resemblance to the mouth of an ox. This resemblance is the more striking, as the whole of this region is covered with glandular skin of a deep-black color, which is either glabrous or provided with a few scattered hairs, but furnished with small flattened warts.

Below the eyes the cheeks are broad and very round, dwindling away and becoming depressed in the lower part of the face. They are seamed with curved wrinkles of varying depth, which tend downward in the same direction as the wrinkles on the lower eyelids. The short upper lip is provided with oblique folds which converge outward in the center. The points of the strong canine teeth, which in many individuals are from thirty-eight to forty millimetres long, and twenty millimetres wide, diverge a little from each other, and stretch the upper lip in an oblique direction, so that this part of the face takes the form of a triangular, beveled surface, with its prominent base-line between the canine teeth. It may also be observed that, in many individuals of this species, the nose is not very deeply set on the upper lip; that in others, again, the nose is decidedly raised, and the lip only presents a small hem below the nose. In many such cases the prognathism of the face is strongly marked, so as to give a baboon-like effect. In other specimens, again, this debased type is not allied with strongly marked prognathism.

If we take a front view of the skull of an aged male gorilla we see that the upper edges of the great supraorbital arches are beveled off below and at the sides. This beveled form is repeated in the broad cheek-bones, as we see them in front. The front view of the head, and indeed of the whole animal, presents a strongly projecting contour, an impression which is strengthened by the puffed cheeks, with their lateral pads of fat. The lower jaw, with its scarcely indicated chin, retreats in the center and dwindles into a triangular form. This contour is characteristic of the species. The whole skin of the face is glossy, set with few hairs, and of a deep-black color.

The ear (Fig. 2) averages sixty millimetres in length, and from thirty-six to forty millimetres in width. It seems to be fastened to the head by the back and upper part, is generally of an oval shape, and furnished with a strongly marked helix. The helix varies in

width in different individuals, and often terminates on its inner edge in the projecting peaked excrescence described by Darwin, of which I shall have more to say presently. The anti-helix, tragus, and anti-tragus, and the cleft which lies between these two latter parts (*incisura inter tragica*) are generally fully developed; the lobule is more rarely present. Individual variations in the special structure of these parts may frequently be observed.

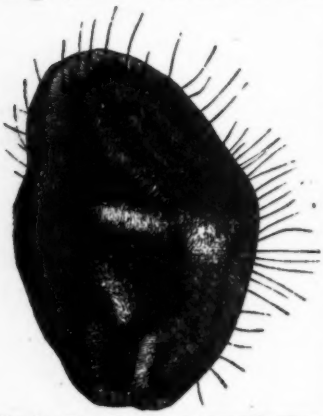

FIG. 2.—EAR OF A MALE ADULT GORILLA.

The strong trapezoid muscles are prominent on the neck, and when the head is stretched they stand out like pillars on the sides of the neck. Owing to the great development of the spinous processes of the cervical vertebræ, and of the muscles attached to them, and to the occipital bones of the skull, the neck is very powerful, almost like that of a bull. The shoulders are remarkable for their breadth, and the pectoral muscles for their large size.

On the upper and forearms the plastic form of the strongly developed flexor and extensor muscles is very apparent, testifying to the enormous strength of the upper extremities. The hands are large, and very wide, with short, thick fingers. The thumb, of which the extremity takes a conical form, is short, extending little beyond the middle of the second metacarpal bone. The extremities of the otherwise broad fingers are somewhat laterally compressed. The fore-finger is not materially shorter than the middle finger. The third finger is sometimes shorter than, sometimes of the same length as, the first, and the fourth is decidedly shorter. The back of the wrist is covered with deep oblique folds. A net-work of wrinkles, oblique or curved, also covers the skin on the back of the fingers, on which there are callosities up to the first joint. The gorilla closes the fingers when going on all-fours, and turns the back of the hand on the ground, thus producing this thickening of the upper skin on the joints. Callosities of the same nature, although not so extensive, are not rare on the second finger-joints. The palm of the hand is covered with a hard, horny skin, generally beset with warts, especially at the roots of the fingers. In spite of the blackness of the skin which covers them, these characteristics are still apparent.

The fingers are united by a strong web, reminding us of the membrane found on the otter and other web-footed animals, and reaching nearly to the first finger-joint. A thick coat of hair extends to the root of the fingers, although on the backs of the fingers there are only a few isolated hairs.

The trunk of the body of a gorilla, seen from behind, somewhat

resembles a trapezium in form, of which the longer of the two parallel sides extends between the shoulders, and the shorter between the two halves of the pelvis. The longitudinal sides, which are not parallel, correspond to the sides of the back. The arrangement of all the lower part of the trunk, on which the bones of the pelvis stand out prominently in an oblique direction, somewhat resembles a four-sided pyramid with its apex reversed. The gluteal muscles are not strongly developed. The tuberosity of the ischium projects in a somewhat angular form.

The thighs are covered with strong muscles, which appear to be smoothed off on the inner side, and somewhat arched on the outside. The lower part of the leg is also muscular, and its section is of a long-oval form; the region of the calf is more strongly developed than in other anthropoids. The bones of the foot are not at all prominent, and the same remark applies to those of the hand. The contour of the back of the long, broad foot is flat; the sole is convex, covered with strong muscles, and padded with layers of fat. When the animal puts the sole of the foot on the ground, its muscles go back to the region of the heel, and forward into the inner side of the foot, thus presenting the primitive formation of a heel.

The great-toe, as in all apes, is detached like a thumb from the other toes, and can be used as such. The metatarsus serves as a base for its projection, in the same manner as the thumb starts from the fore part of the contour of the wrist. The great-toe sometimes extends as far as the joint between the first and second phalanges of the second toe, sometimes nearly as far as the middle of the second phalanx. This characteristic varies in different individuals. At the point of union of the first metatarsal bone with the hinder extremity of the first phalanx of the great-toe, there is a round projection on the inner side of the foot. The great-toe is very broad at its root, then becomes smaller, and widens again into a broad final phalanx. With its strong lateral ridges of skin, which cover the sinews and cushions of fat, all this part of the foot appears to be wide and flattened off from the back to the sole.

The second, third, fourth, and fifth toes are more slender than the great-toe. The second toe is in most cases rather shorter than the third. The third and fourth toes are almost of the same length, and only a little longer than the second toe.* The fifth toe is considerably shorter than the fourth. The last phalanges of the toes taper in front, and are furnished on their lower surface with long, laterally compressed pads. The section of such a phalanx is almost trapezoidal, with a long upper parallel side. The upper part of the foot, although generally flat, rises a little in the neighborhood of the first metatarsal bone, and slopes thence to its outer edge.

The hair grows thickly on the back of the foot, as far as the ex-

* Compare Isidore Geoffroy Saint-Hilaire, table v; also Hartmann, "Der Gorilla," p. 14, Anm 4.

tremity of the metatarsal bones, more sparsely on the back of the toes. There are strongly marked oblique furrows on this part of the foot, especially on the joints, often combined with horny callosities, since

FIG. 3.—THE YOUNG MALE GORILLA, FROM THE SPECIMEN IN THE BERLIN AQUARIUM OF 1876-'77.

the animal sometimes doubles up the toes and runs upon the back of them. The nails of the hands and feet are black, like the whole of their skin-covering, distinctly grooved, very much arched, and generally somewhat wider at the base than in front.

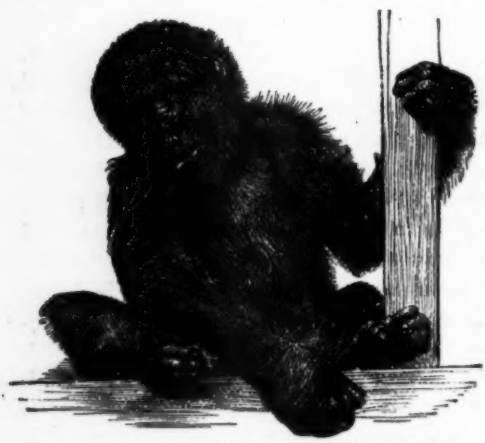

FIG. 4.—THE SAME ANIMAL AT A STILL EARLIER AGE.

On the sole of the foot we find the region of the heel, the ball of the great-toe, in this case resembling the ball of a thumb, the roots and tips of the toes, together with pads consisting of muscles, tendons, and skin. The several divisions of these padded balls are separated from each other by furrows which are longitudinal, oblique, and transverse, and more or less distinct from each other. The black skin which covers the sole

of the foot is thick and horny, but provided with a series of papillæ. The whole skin of an aged animal is of a deep-black color, somewhat glossy, and covered with intersecting wrinkles.

The young male gorilla does not essentially differ from the old male in its general and external appearance. Its skull is, however, without the crest which characterizes the latter animal, and is still of a rounded form in the region of the crown and occiput. At this age the head is not so high at the back and on the top as in aged males. The orbits are less prominent, the general aspect of the face is not so decidedly prognathous, and the bridge of the nose is shorter. The lines of the body in the young male are softer and less exaggerated, and the expression of the face is less ferocious than in an aged male. The horny callosities on the hands and feet are altogether wanting or only faintly indicated, and the hands, fingers, and toes have not arrived at the powerful development which we observe in the older animal.

Considerable differences may be observed in the whole structure of the adult female gorilla. The animals of this sex are smaller and weaker than males of the same age. The skull of the female is smaller and more rounded than that of the male, and the great bony crests are also absent. The orbits are less prominent, and a front view of the head gives the impression of a trapezoidal form. The coronal arch rises above this trapezoid. In the male, on the contrary, the crown seems to lengthen above and behind into a pyramidal form. In the aged female the bridge of the nose is generally shorter than in the aged male; but even in this particular there is great variation in different individuals. Sometimes the bridge of the nose in a female is much depressed, and then the interval between the orbits and the end of the nose is shorter: I intentionally avoid the term *tip* of the nose, on account of the blunted form of this organ. Even when the bridge of the nose is more prominent, the interval between its end and the orbits is sometimes very short.

The aged female gorilla usually has wider cheeks, a smaller nose, and a higher upper lip. This last peculiarity is shown in the correct and well-stuffed specimens in the museums at Paris and Lübeck. Although in the process of drying the skin of the nose may have shrunk a little, yet there is still room for the upper lip, provided with folds which are either vertical and parallel or diverge like a fan. Owen and Mützel* have given satisfactory illustrations of these parts. In the aged female the shape of the neck is not, as in the aged male, strong and bulging, so as to resemble a cowl. Yet it is enlarged in conformity with the not inconsiderable development of the spinous processes of the cervical vertebræ, and with that of the powerful cervical muscles. Even in a young male, of the age of the specimen which was kept in the Berlin Aquarium, between July, 1876, and November, 1877,

* Owen, "Memoir," etc., plate ii; Brehm, "Thierleben," vol. i, p. 56.

this enlargement of the neck was present in a marked degree. In still younger individuals, however, under a year old, in which the spinous processes of the vertebræ have not yet been developed, there is no such enlargement, but, on the contrary, this region of the neck takes a concave form.

In conformity with the smaller size of the body, the shoulders, arms, and thighs of the adult female are smaller than those of the full-grown male, but they are still very powerful. While giving suck, the breasts of the female are swelled in the form of a half-cone, instead of assuming the convex shape which is observed in many European women, and still more frequently in those of the negro, Indian, and South Sea races. The nipple is cylindrical rather than conical in shape, and covered with finely wrinkled black skin, which is sometimes hard and horny. When not giving suck, the breasts hang slackly down, like short empty pouches.

In a young female the cranium is rounded, and the face is only slightly prominent. In aged specimens, especially in those of the male sex, there is a somewhat typical prolongation of that part of the face which lies between the eyes and the end of the nose, and this is to a slight extent apparent in the young female. Variations in form and in the extent of the prolongation are, however, apparent even at this early period. The trunk and limbs are more slenderly built than in a male of the same age.

The hairy coat of the gorilla consists of long, thick, straight or stiffly curved bristles, and also of shorter, thinner, and curled woolly hair. On the crown of the head the hair is somewhat stiff, from twelve to twenty millimetres in length, and it becomes erect under the influence of anger. While the sides and fore part of the chin are only clothed with short, stiff hairs, they grow thickly on the back part of the chin, like a beard or forelock. The hairs which turn outward from the sides of the face and on the neck are thirty or more millimetres in length. On the shoulders the hair is from one hundred and thirty to one hundred and fifty millimetres long, hanging down on the upper arms and the back. In the middle of the upper arm the hair is from fifty to seventy millimetres long, growing downward as far as the bend of the elbow. At this point it generally begins to grow in an upward direction. On the back of the forearm it again grows downward. In the middle of the forearm, on its inner side, a parting of the hairs takes place, as one portion goes in front of the radius, while the other portion turns behind the ulna. On the back of the wrist a tuft of curved hair turns upward ; a middle tuft goes directly back ; and the lower tuft, also curved, turns outward. On the back of the hand the hairs turn toward the fingers. On the breast and belly the hairs are shorter and grow more sparsely. On the breast their direction is, as a rule, upward and outward. On the belly they converge from the ribs toward the center and the navel. On the

thighs the hairs are about one hundred and sixty millimetres long, and here, as on the lower part of the leg, they tend outward, while on the back of the foot they grow toward the toes. On the back, shoulders, and on the thigh and leg, the bristles are slightly curved. This quality increases the general impression of shagginess and fleeciness which is produced by the hairy coat of these creatures. The woolly hair does not grow very thick, and is not much matted.

The color of the hair not only differs on different parts of the body, but also in different individuals. On the crown of the head it is of a reddish-brown, or rarely of a decided brown or black. The hairs in this region are sometimes dun-colored at the root, grayish-white in the center, and brownish-red, shading into the dark-brown tip. The hair on the lips is sometimes of a blackish-brown, sometimes whitish, or both colors are found together. The hair growing at the sides of the face is gray below, dark brown or almost black above. On the neck and shoulders the hair is of a gray color at the root, and gradually becomes lighter toward the tip. In the center it is brown, shading into a lighter color at either end; but this ringed form of color is not universal. The tips of the hair are dark, sometimes brown or reddish. The hair on the back, on the upper arms and thighs, is whitish or light gray for half its length, with a blackish-brown ring toward the tip, which is of a dark-gray color. Many of these hairs on the back have two brown rings on them. The forearms, hands, shanks, and feet are covered with hairs which are gray at the root, brownish gray, dark brown, or black at the tip. Round the posteriors there is a circle of white, gray, or brownish-yellow hairs, from ten to twenty millimetres in length. In both sexes variations from the color of the coat here described are not rare. It has been already observed that the brownish-red color of the hair on the head is sometimes exchanged for another shade. In many individuals the neck, shoulders, and back are of a dark gray, brown, or even black color. In others the forearms, hands, shanks, and feet are covered, like the rest of the body, with gray and brown hair intermingled.

The second species of anthropoid apes is the chimpanzee. In this case also we must consider successively the aged and young male, and the aged and young female animals.

The full-grown chimpanzee is smaller than the adult gorilla. In this species also the male is larger than the female. The chimpanzee is, speaking generally, of a slighter build than the gorilla.

The head of the aged male chimpanzee fundamentally differs from that of the aged male gorilla, since the skull of the former has a depressed crown, and the transverse occipital ridge is only faintly indicated. Since the orbits are also less strongly developed than in the aged male gorilla, and the spinous processes of the cervical vertebræ do not assume the same elevated form which is characteristic of the latter species, the countenance of the chimpanzee is not of a square

shape, and there is not space for the strong muscular system arching over the neck like a cowl, which is so characteristic of the gorilla. The head of the chimpanzee displays, both in aged and young specimens, the concave neck which is common among apes, that is to say, a depression between the head and the throat. In an aged male the crown of the head presents a rounded, arched contour, since, as we have already said, the prominent bony processes are wanting. Although the supraorbital arches are not so excessively prominent as in a gorilla of the same age, they are strongly developed, covered with wrinkled skin, and in this case also there is a species of eyebrow, stiff and bristly, with shorter hairs between. The large, wrinkled lids are furnished with thick eyelashes. The inner angle of the eye somewhat resembles that of the gorilla.

A general physiognomical distinction between the gorilla and the chimpanzee consists in the fact that the bridge of the nose is shorter in the latter than in the former. In the chimpanzee this part of the organ is depressed, yet the depression is of a conical and convex form, and is covered with a net-work of wrinkles of varying depth. In the chimpanzee the interval between the inner angle of the eye and the upper lateral contour of the cartilaginous end of the nose is shorter than in the gorilla. There is also some difference in the form of the nose: it is on the whole flatter, the tip is less apparent, the nostrils are not so widely opened nor so thickly padded. (Fig. 3.) In the chimpanzee, as well as in the gorilla, a central and vertical furrow directly divides the triangular nostrils, and these are likewise divided from the rest of the face by the broad pear-shaped furrow which surrounds them. The upper lip is generally high, sometimes as high as thirty millimetres; but in some individuals it is much lower. As in the gorilla, the chin forms a triangle of equal sides, with its apex reversed.

The external ear of the chimpanzee has on the whole less resemblance to the human ear, and its contour is larger than that of the gorilla. But this organ varies so much in individuals that it is difficult to lay down any rule for its average size. It ranges from fifty-nine to seventy-seven millimetres in length, and from forty-two to eighty millimetres in width. Many individuals have a distinct lobule to the ear, others not. (Fig. 5.) In this example the helix and anti-helix are developed, in others they are wanting. The tragus and anti-tragus are more or less apparent in different individuals, as well as the other modifications of the external cartilage of the ear.

An aged male chimpanzee has broad, rather rounded shoulders, a powerful chest, long, muscular arms, reaching to the knees, and a long hand, which seems to be very slender in comparison with that of the gorilla. The thumbs vary in length, for the most part reaching as far as the metacarpal phalanges, but not in all cases. The middle finger is longer than the other three; the first and third fingers are shorter

by the length of the last phalanx, the third is a little longer than the first, and the fourth is again shorter. A web, which reaches to the middle of the first row of phalanges, stretches between the bases of the four fingers. There are horny callosities on the back of the hand of the aged male, since the chimpanzee, like the gorilla, supports himself on the backs of his closed fingers. The fingers are laterally compressed, but slightly arched on the back of the hand, and more decidedly so on the palm. A net-work of furrows covers the back of the hand, and these are more deeply impressed on its palm. The thumb is separated from the palm by a distinct furrow; and from four to six furrows of varying depth cross the center of the palm. The finger-nails are short, wide, and arched, very convex at their free edges.

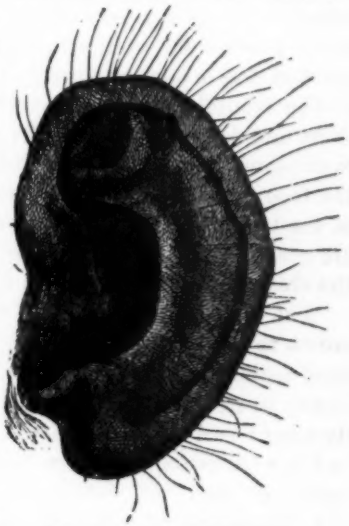

FIG. 5.—EAR OF CHIMPANZEE.

In the aged male the sides of the belly are compressed, the thighs are broad and muscular, and somewhat flattened both on the inner and outer sides. The knees are rather prominent, the shanks are somewhat laterally compressed, and the calf of the leg is very slightly developed. As in the gorilla, the long, wide feet have a thumb-like formation of the great-toes, which are of considerable size. They extend, when drawing anything toward them, as far as the second phalanx of the second toe. The four other toes are more slender, and only a little longer than the great-toe. The heel is but slightly developed, and slopes away below. The joint between the first phalanx of the great-toe and the first metatarsal bone is marked by an angular projection on the inner edge of the foot. The back of the foot is very slightly convex. The last phalanx of the great-toe is very much sloped off on its upper surface, but this is less apparent in the other parts of this member. The last phalanges of the other laterally compressed toes are strongly arched on the under surface. Considerable convexities may also be observed under the metacarpo-phalangeal joint of the great-toe, and under its last phalanx. The shape of the toe-nails resembles that of the fingers. Large callosities are not unfrequently found on the backs of the toes, since the animal sometimes supports himself on these parts. A connective web is found between all the toes, except the great-toe and its neighbor, but it does not extend so far as that between the roots of the fingers.

Although the young male chimpanzee is distinguished from the aged male of the same species by differences in the structure of many

of its parts, yet these distinctions are not so characteristic as those between the young and aged male gorillas. The skull of the younger animal, which is altogether devoid of the prominent bony crest and ridges, is shaped almost like a truncated cone in the region of the crown; in some individuals of only a few years old the bony development of the orbits has already begun, starting from the principal part of the frontal bone, and covered with pads of wrinkled skin. The short and depressed bridge of the nose becomes longer and higher, the cartilaginous end of the nose becomes larger, and the prognathism of the face increases with each successive stage of growth. The strength of the trunk and limbs is early developed. The sexual characteristics are gradually and plainly developed; but the male gorilla far exceeds the chimpanzee in demoniacal ferocity.

The adult female is smaller, and has a smaller head, with an oval crown to the skull. The orbits are not so strongly developed as in the aged male, the nasal parts are less prominent, and the teeth are not nearly so strong. The body of an animal of this sex is rounder in all its parts; and the belly, with its wider pelvis, is more tun-shaped than in the aged male. Neither do the limbs display the same angular formation of muscles.* The hands and feet of the female are also smaller and slenderer. In a young female the characteristics here describep are presented in the mitigated form which corresponds with its youthful condition. But the female sometimes becomes a very strong and even violent creature. This was often proved in the Hamburg Zoölogical Garden, where a female specimen, in splendid condition, survived for several years under the faithful care of old Siegel.†

The skin of the chimpanzee is of a peculiar light, yet muddy flesh color, which sometimes verges upon brown. Spots, varying in size and depth of color, sometimes isolated, sometimes in groups, and of a blackish-brown, sooty, or bluish-black tint, are found on different parts of the body of many individuals, especially on the face, neck, breast, belly, arms and hands, thighs and shanks; more rarely on the back. The face, which is soon after birth of a flesh color, merging into a yellowish-brown, assumes a darker shade with the gradual development of the body. The hairy coat is sleek, or only in rare cases slightly curled, and the coarser and bristly hair is generally stiff and elastic. The parting on the forehead is often so regular that it might have been arranged by the hairdresser's art (see Fig. 6). Close behind that part of the head at which the projecting supraorbital ridges of the gorilla generally meet, there is in the chimpanzee an altogether bald place, or only a few scattered hairs. Round the face the growth

* Compare Hartmann, "Der Gorilla," Fig. 8. This is undoubtedly one of the most successful illustrations of the chimpanzee, its habits, expression, and disposition.

† Compare Hartmann, "Der Gorilla," Fig. 27, representing the Hamburg animal in middle age. Fig. 6 gives the wild Paulina of the German Loango expedition. The inscription, by an error of the press, states that it is a male, not a female chimpanzee.

of hair streams downward like a beard. On the neck it is from sixty to eighty or one hundred millimetres in length, and it falls in the same long locks over the shoulders, back, and hips. The hair on the limbs is not so long, and takes a downward direction on the upper arm, and an opposite direction on the forearm, while there is often a longitudinal parting on the center of the inner surface of this part of the limb.

FIG. 6.—YOUNG CHIMPANZEE.

On the back of the wrist the hair grows in a kind of whorl; the upper hairs turn upward and backward, the middle ones turn backward, the lower ones backward and downward. The backs of the hands and the roots of the fingers are hairy. On the front of the thigh the hair takes a downward direction, while behind it grows backward. On the shank it grows downward in the region of the tibia, and turns back on the inside of the leg. The back of the foot and the roots of the toes are likewise hairy. There is a shorter growth of these scattered hairs on the face, chin, and ears. On the supraorbital arches there are from

eight to twenty, or even more, stiff, scattered hairs, after the manner of eyebrows; and eyelashes are likewise present.

In most cases the hair of the true chimpanzee is of a black color. Short whitish hairs may be observed on the lower part of the face and chin, as well as round the posteriors. Sometimes the color of the hair is shot throughout with reddish or brownish black.

The orang-outang, the chief representative of the anthropoids in Asia, differs from the African forms of this group, almost at the first glance, in the height of his skull, of which the fore part is compressed and shortened in a backward direction. In the aged male it is, however, provided with high and erect bony crests, which give a prognathous appearance to the countenance. We take an aged male as the type of our description.

The forehead is high and erect, not retreating like that of the chimpanzee; it is open, and has moderately convex frontal eminences. From the center of the forehead a round or bluntly oval eminence sometimes projects. The supraorbital ridges are strongly arched, yet not so prominent as that of the aged male chimpanzee, setting aside that of the gorilla. The eyes are not widely opened, nor are their lids large and furrowed, but on the lower lids there are deep wrinkles. The small bridge of the nose is generally much depressed, but sometimes assumes a slightly conical form as it issues from the central longitudinal depression of the face. The end of the nose, farther removed from the eyes than is generally the case in the chimpanzee, is not so broad as it is in the latter animal and in the gorilla. The wings of the nose are narrow and highly arched in their upper part, divided from each other by a vertical furrow, and the nostrils are small and oval, separated by a thin partition. The upper lip is high, broad, and projecting, and seldom much wrinkled. It is divided from the cheeks and from the upper part of the face by a deep depression; and behind the cheeks two large and long-shaped or sometimes triangular pads of fat often project forward and downward.

The very mobile lips are furrowed, and not remarkably thick. The chin is very retreating, but somewhat uniformly rounded in front (Fig. 7). The small ear averages fifty-five millimetres in length, and twelve millimetres in width, and has a general resemblance in structure to the human ear (Fig. 8). On the fore part of the short, thick neck there are irregular, and in some places very deep, circular folds of skin. The throat-pouch distends part of this slack, wrinkled skin, which hangs down in front like a great empty wallet (see Figs. 7 and 9).

The structure of the other parts of the body lacks even, to some extent, the powerful and symmetrical formation which we observe in the gorilla, and indeed in the chimpanzee. The trunk, with broad yet rather angular and sloping shoulders, with flattened breast, rounded back, and still more rounded belly, is tun-shaped, and gives the impression of a want of proportion. In lean individuals the gluteal

region resembles the projecting rump of a fowl, and this may also be observed in the young gorilla and chimpanzee. The long, muscular arms reach to the ankles when the animal is in an erect position, and are altogether out of proportion with the rest of the body. The pow-

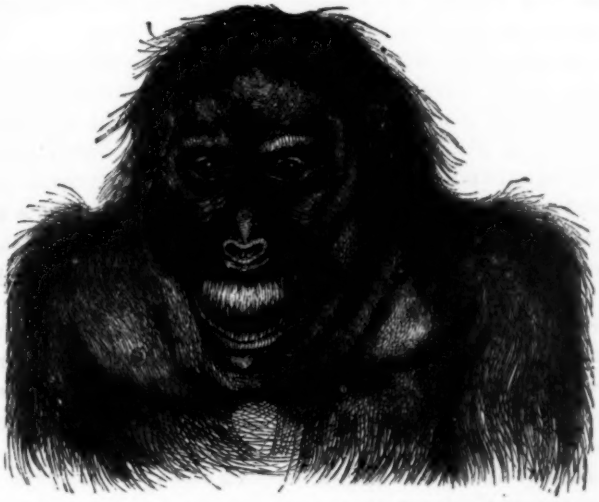

FIG. 7.—HEAD AND SHOULDERS OF AN AGED MALE ORANG-OUTANG.

erful upper arm is shorter than the lean forearm. The hand is long and narrow. The thumb, which reaches as far as the metacarpo-phalangeal joint, has a displeasing and almost rudimentary effect. A web unites the fingers, sometimes extending along a third of the first phalanx, sometimes along half. The middle finger is somewhat longer than the first and third fingers, and the third is next to it in length. The fourth finger is comparatively long. The palm of the hand is flat, only marked by a few deep furrows. The long, slender fingers are laterally compressed, and the nails on their tapering ends are arched.

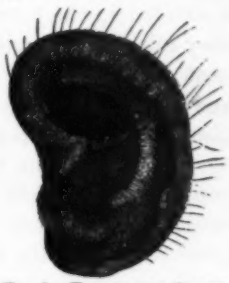

FIG. 8.—EAR OF THE ORANG-OUTANG.

The thighs, somewhat compressed on the inner side, are, however, very muscular, but become much smaller on their back side. The calf of the leg is less developed than in the gorilla, or even than in the chimpanzee. The feet are, like the hands, long and slender. The narrow, flat heels, project very slightly behind. The great-toes are short, with wide extremities, rounded above, and provided on the sole with thick, fatty skin. In old age these animals not only often lose the nails of their great-toes, but sometimes even the last phalanges themselves. This is not merely a disease produced by confinement, as is the case with sea-cat monkeys, hyenas, etc., which in this condi-

tion lose portions of their tails or toes, but it also occurs among orang-outangs in their wild state. The middle toe is the longest, and the fourth toe is the shortest. Layers of fat may be observed on the under side of all but the great-toe, where they rarely occur. The backs of the hands and feet are covered with very ribbed and wrinkled skin, and on the hands there are callosities.

This animal, of a quieter and more phlegmatic disposition than the gorilla and chimpanzee, has a very strange appearance, with its projecting head and short neck; its face widening in the middle and tapering toward the forehead and chin; its tun-shaped trunk, long, thin extremities, and shaggy coat. It differs widely from the chimpanzee and gorilla in these particulars. In the young male the compression of the forehead is less marked than in aged animals, and the bony crests which conduce to raise the coronal arch in its upper and hinder part are also absent. The supraorbital arches are less strongly developed, the jaws are less prominent, and the layers of fat upon the cheeks are absent. The head is more detached from the neck, the structure of the whole body is slenderer, the expression of the countenance is milder. A small, conical nail, blunted at the end, may generally be observed on the great-toe.

In the adult female, as I have pointed out elsewhere, the physical characteristics of the young male are repeated in an exaggerated form. The skull, displaying only very small bony crests, is indeed high, but more rounded than in the aged male; the face is prominent, but the head is more detached from the neck than in the latter case. On account of the greater width of the pelvis, the body is still more tun-shaped than in the aged male. When giving suck, the breasts are distended in the form of a half cone, but when this condition ceases they fall together and only present two short, wrinkled, slightly prominent folds of skin; the small, horny nipples are almost cylindrical; and the areola, of which the traces are scanty at all times, altogether disappears. The throat-pouch is less strongly developed than in the aged male, but the limbs are as fully developed. The head of the young female is still more rounded, with a more flattened though still projecting face, and the limbs are slenderer, and thus still more out of proportion with the thick trunk than is the case with a young male.

The orang-outang's skin is of a grayish-blue color, sometimes mixed with brown, but the grayish-blue shade is predominant. A yellowish or brownish gray is less common. Round the eyes, nostrils, upper lips, and chin, there is often a ring of a dirty, yellowish-brown color, forming a strange contrast with the general bluish-gray tone of the face. The arms, legs, hands, and feet are black or grayish-black, more rarely brown or reddish-brown.

The hairy coat of the orang-outang consists of long, curved, waving bristles, and some scanty downy hairs. On the back of the head, on the shoulders, back, and hips, I have measured hairs from two hundred

and twenty to two hundred and thirty-five millimetres in length. In other individuals they were, however, much shorter—twenty, forty, or sixty millimetres long. There is often a natural parting of the hair of the head, which falls asunder on either side. In some cases there is no parting, and the hair streams wildly down; and in others, again, it stands upright, stiffening from the sides and top of the head in a demoniacal manner (Figs. 7 and 9). A beard frequently encircles the

FIG. 9.—ADULT MALE ORANG-OUTANG.

cheeks and chin. The hair grows upward and outward on the neck and fore part of the throat, on the shoulders, back, breast, belly, upper arms, and thighs, while it takes the opposite direction on the forearm. On the wrist the hair grows in the manner described in the case of the gorilla. There is only a scanty growth of hair on the breast and belly,

and it is also short and weak on the face, ears, and backs of the hands and feet. I have not observed eyebrows on the animals I have seen, but they may occur, and the eyelashes are fully developed.

The hair is of a reddish-brown color, something like burnt sienna, and the hair-tips on the back parts of the body are generally brown. In some individuals the hair is darker, of a russet or blackish brown; in others it is lighter, and in the latter case the breast and belly are of a yellowish white. The beard is sometimes dark yellow. Some individuals almost devoid of hair have been observed.

THE FACTORS OF ORGANIC EVOLUTION.

By HERBERT SPENCER.

I.

WITHIN the recollection of men now in middle life, opinion concerning the derivation of animals and plants was in a chaotic state. Among the unthinking there was tacit belief in creation by miracle, which formed an essential part of the creed of Christendom; and among the thinking there were two parties, each of which held an indefensible hypothesis. Immensely the larger of these parties, including nearly all whose scientific culture gave weight to their judgments, though not accepting literally the theologically-orthodox doctrine, made a compromise between that doctrine and the doctrines which geologists had established; while opposed to them were some, mostly having no authority in science, who held a doctrine which was heterodox both theologically and scientifically. Professor Huxley, in his lecture on "The Coming of Age of the Origin of Species," remarks concerning the first of these parties as follows:

"One-and-twenty years ago, in spite of the work commenced by Hutton and continued with rare skill and patience by Lyell, the dominant view of the past history of the earth was catastrophic. Great and sudden physical revolutions, wholesale creations and extinctions of living beings, were the ordinary machinery of the geological epic brought into fashion by the misapplied genius of Cuvier. It was gravely maintained and taught that the end of every geological epoch was signalized by a cataclysm, by which every living being on the globe was swept away, to be replaced by a brand-new creation when the world returned to quiescence. A scheme of nature which appeared to be modelled on the likeness of a succession of rubbers of whist, at the end of each of which the players upset the table and called for a new pack, did not seem to shock anybody.

I may be wrong, but I doubt if, at the present time, there is a single responsible representative of these opinions left. The progress of scientific geology has elevated the fundament principle of uniformitarianism, that the explanation

of the past is to be sought in the study of the present, into the position of an axiom; and the wild speculations of the catastrophists, to which we all listened with respect a quarter of a century ago, would hardly find a single patient hearer at the present day."

Of the party above referred to as not satisfied with this conception described by Professor Huxley, there were two classes. The great majority were admirers of the *Vestiges of the Natural History of Creation*—a work which, while it sought to show that organic evolution has taken place, contended that the cause of organic evolution is "an impulse" supernaturally "imparted to the forms of life, advancing them . . . through grades of organization." Being nearly all very inadequately acquainted with the facts, those who accepted the view set forth in the *Vestiges* were ridiculed by the well-instructed for being satisfied with evidence, much of which was either invalid or easily cancelled by counter-evidence, and at the same time they exposed themselves to the ridicule of the more philosophical for being content with a supposed explanation which was in reality no explanation—the alleged "impulse" to advance giving us no more help in understanding the facts than does Nature's alleged "abhorrence of a vacuum" help us to understand the ascent of water in a pump. The remnant, forming the second of these classes, was very small. While rejecting this mere verbal solution, which both Dr. Erasmus Darwin and Lamarck had shadowed forth in other language, there were some few who, rejecting also the hypothesis indicated by both Dr. Darwin and Lamarck, that the promptings of desires or wants produced growths of the parts subserving them, accepted the single *vera causa* assigned by these writers—the modification of structures resulting from modification of functions. They recognized as the sole process in organic development the adaptation of parts and powers consequent on the effects of use and disuse—that continual moulding and remoulding of organisms to suit their circumstances, which is brought about by direct converse with such circumstances.

But while this cause accepted by these few is a true cause, since unquestionably during the life of the individual organism changes of function produce changes of structure; and while it is a tenable hypothesis that changes of structure so produced are inheritable, yet it was manifest to those not prepossessed, that this cause cannot with reason be assigned for the greater part of the facts. Though in plants there are some characters which may not irrationally be ascribed to the direct effects of modified functions consequent on modified circumstances, yet the majority of the traits presented by plants are not to be thus explained. It is impossible that the thorns by which a briar is in large measure defended against browsing animals, can have been developed and moulded by the continuous exercise of their protective actions; for in the first place, the great majority of the thorns are

never touched at all, and, in the second place, we have no ground whatever for supposing that those which are touched are thereby made to grow, and to take those shapes which render them efficient. Plants which are rendered uneatable by the thick woolly coatings of their leaves, cannot have had these coatings produced by any process of reaction against the action of enemies; for there is no imaginable reason why, if one part of a plant is eaten, the rest should thereafter begin to develop the hairs on its surface. By what direct effect of function on structure can the shell of a nut have been evolved? Or how can those seeds which contain essential oils, rendering them unpalatable to birds, have been made to secrete such essential oils by these actions of birds which they restrain? Or how can the delicate plumes borne by some seeds, and giving the wind power to waft them to new stations, be due to any immediate influences of surrounding conditions? Clearly in these and in countless other cases, change of structure cannot have been directly caused by change of function. So is it with animals to a large extent, if not to the same extent. Though we have proof that by rough usage the dermal layer may be so excited as to produce a greatly thickened epidermal layer, sometimes quite horny; and though it is a feasible hypothesis that an effect of this kind persistently produced may be inherited; yet no such cause can explain the carapace of the turtle, the armor of the armadillo, or the imbricated covering of the manis. The skins of these animals are no more exposed to habitual hard usage than are those of animals covered by hair. The strange excrescences which distinguish the heads of the hornbills, cannot possibly have arisen from any reaction against the action of surrounding forces; for even were they clearly protective, there is no reason to suppose that the heads of these birds need protection more than the heads of other birds. If, led by the evidence that in animals the amount of covering is in some cases affected by the degree of exposure, it were admitted as imaginable that the development of feathers from preceding dermal growths had resulted from that extra nutrition caused by extra superficial circulation, we should still be without explanation of the structure of a feather. Nor should we have any clue to the specialities of feathers—the crests of various birds, the tails sometimes so enormous, the curiously placed plumes of the bird of paradise, etc. Still more obviously impossible is it to explain as due to use or disuse the colors of animals. No direct adaptation to function could have produced the blue protuberances on a mandril's face, or the striped hide of a tiger, or the gorgeous plumage of a kingfisher, or the eyes in a peacock's tail, or the multitudinous patterns of insects' wings. One single case, that of a deer's horns, might alone have sufficed to show how insufficient was the assigned cause. During their growth, a deer's horns are not used at all; and when, having been cleared of the dead skin and dried-up blood-vessels covering them, they are ready

for use, they are nerveless and non-vascular, and hence are incapable of undergoing any changes of structure consequent on changes of function.

Of these few, then, who rejected the belief described by Professor Huxley, and who, espousing the belief in a continuous evolution, had to account for this evolution, it must be said that though the cause assigned was a true cause, yet, even admitting that it operated through successive generations, it left unexplained the greater part of the facts. Obviously the facts that were congruous with the espoused view, monopolized consciousness, and kept out the facts that were incongruous with it—conspicuous though many of them were. The misjudgment was not unnatural. Finding it impossible to accept any doctrine which implied a breach in the uniform course of natural causation, and, by implication, accepting as unquestionable the origin and development of all organic forms by accumulated modifications naturally caused, that which appeared to explain certain classes of these modifications, was supposed to be capable of explaining the rest: the tendency being to assume that these would eventually be similarly accounted for, though it was not clear how.

Returning from this parenthetic remark, we are concerned here chiefly to remember that, as said at the outset, there existed thirty years ago, no tenable theory about the genesis of living things. Of the two alternative beliefs, neither would bear critical examination.

Out of this dead lock we were released—in large measure, though not I believe entirely—by the *Origin of Species*. That work brought into view a further factor; or, rather, such factor, recognized as in operation by here and there an observer (as pointed out by Mr. Darwin in his introduction to the second edition), was by him for the first time seen to have played so immense a part in the genesis of plants and animals.

Though laying myself open to the charge of telling a thrice-told tale, I feel obliged here to indicate briefly the several great classes of facts which Mr. Darwin's hypothesis explains; because otherwise that which follows would scarcely be understood. And I feel the less hesitation in doing this because the hypothesis which it replaced, not very widely known at any time, has of late so completely dropped into the background, that the majority of readers are scarcely aware of its existence, and do not therefore understand the relation between Mr. Darwin's successful interpretation and the preceding unsuccessful attempt at interpretation. Of these classes of facts, four chief ones may be here distinguished.

In the first place, such adjustments as those exemplified above are made comprehensible. Though it is inconceivable that a structure like that of the pitcher-plant could have been produced by accumulated effects of function on structure; yet it is conceivable that suc-

cessive selections of favorable variations might have produced it; and the like holds of the no less remarkable appliance of the Venus's Fly-trap, or the still more astonishing one of that water-plant by which infant-fish are captured. Though it is impossible to imagine how, by direct influence of increased use, such dermal appendages as a porcupine's quills could have been developed; yet, profiting as the members of a species otherwise defenceless might do by the stiffness of their hairs, rendering them unpleasant morsels to eat, it is a feasible supposition that from successive survivals of individuals thus defended in the greatest degrees, and the consequent growth in successive generations of hairs into bristles, bristles into spines, spines into quills (for all these are homologous), this change could have arisen. In like manner, the odd inflatable bag of the bladder-nosed seal, the curious fishing-rod with its worm-like appendage carried on the head of the *lophius* or angler, the spurs on the wings of certain birds, the weapons of the sword-fish and saw-fish, the wattles of fowls, and numberless such peculiar structures, though by no possibility explicable as due to effects of use or disuse, are explicable as resulting from natural selection operating in one or other way.

In the second place, while showing us how there have arisen countless modifications in the forms, structures, and colors of each part, Mr. Darwin has shown us how, by the establishment of favorable variations, there may arise new parts. Though the first step in the production of horns on the heads of various herbivorous animals, may have been the growth of callosities consequent on the habit of butting—such callosities thus functionally initiated being afterward developed in the most advantageous ways by selection; yet no explanation can be thus given of the sudden appearance of a duplicate set of horns, as occasionally happens in sheep: an addition which, where it proved beneficial, might readily be made a permanent trait by natural selection. Again, the modifications which follow use and disuse can by no possibility account for changes in the numbers of vertebræ; but after recognizing spontaneous, or rather fortuitous, variation as a factor, we can see that where an additional vertebra hence resulting (as in some pigeons) proves beneficial, survival of the fittest may make it a constant character; and there may, by further like additions, be produced extremely long strings of vertebræ, such as snakes show us. Similarly with the mammary glands. It is not an unreasonable supposition that by the effects of greater or less function, inherited through successive generations, these may be enlarged or diminished in size; but it is out of the question to allege such a cause for changes in their numbers. There is no imaginable explanation of these save the establishment by inheritance of spontaneous variations, such as are known to occur in the human race.

So too, in the third place, with certain alterations in the connexions of parts. According to the greater or smaller demands made on this

or that limb, the muscles moving it may be augmented or diminished in bulk; and, if there is inheritance of changes so wrought, the limb may, in course of generations, be rendered larger or smaller. But changes in the arrangements or attachments of muscles can not be thus accounted for. It is found, especially at the extremities, that the relations of tendons to bones and to one another are not always the same. Variations in their modes of connexion may occasionally prove advantageous, and may thus become established. Here again, then, we have a class of structural changes to which Mr. Darwin's hypothesis gives us the key, and to which there is no other key.

Once more there are the phenomena of mimicry. Perhaps in a more striking way than any others, these show how traits which seem inexplicable are explicable as due to the more frequent survival of individuals that have varied in favorable ways. We are enabled to understand such marvellous simulations as those of the leaf-insect, those of beetles which "resemble glittering dew-drops upon the leaves;" those of caterpillars, which, when asleep, stretch themselves out so as to look like twigs. And we are shown how there have arisen still more astonishing imitations—those of one insect by another. As Mr. Bates has proved, there are cases in which a species of butterfly, rendered so unpalatable to insectivorous birds by its disagreeable taste that they will not catch it, is simulated in its colors and markings by a species which is structurally quite different—so simulated that even a practised entomologist is liable to be deceived: the explanation being that an original slight resemblance, leading to occasional mistakes on the part of birds, was increased generation after generation by the more frequent escape of the most-like individuals, until the likeness became thus great.

But now, recognizing in full this process brought into clear view by Mr. Darwin, and traced out by him with so much care and skill, can we conclude that, taken alone, it accounts for organic evolution? Has the natural selection of favorable variations been the sole factor? On critically examining the evidence, we shall find reason to think that it by no means explains all that has to be explained. Omitting for the present any consideration of a factor which may be distinguished as primordial, it may be contended that the above-named factor alleged by Dr. Erasmus Darwin and by Lamarck, must be recognized as a co-operator. Utterly inadequate to explain the major part of the facts as is the hypothesis of the inheritance of functionally-produced modifications, yet there is a minor part of the facts, very extensive though less, which must be ascribed to this cause.

When discussing the question more than twenty years ago (*Principles of Biology*, § 166), I instanced the decreased size of the jaws in the civilized races of mankind, as a change not accounted for by the natural selection of favorable variations; since no one of the decre-

ments by which, in thousands of years, this reduction has been effected, could have given to an individual in which it occurred, such advantage as would cause his survival, either through diminished cost of local nutrition or diminished weight to be carried. I did not then exclude, as I might have done, two other imaginable causes. It may be said that there is some organic correlation between increased size of brain and decreased size of jaw: Camper's doctrine of the facial angle being referred to in proof. But this argument may be met by pointing to the many examples of small-jawed people who are also small-brained, and by citing not infrequent cases of individuals remarkable for their mental powers, and at the same time distinguished by jaws not less than the average but greater. Again, if sexual selection be named as a possible cause, there is the reply that, even supposing such slight diminution of jaw as took place in a single generation to have been an attraction, yet the other incentives to choice on the part of men have been too many and great to allow this one to weigh in an adequate degree; while, during the greater portion of the period, choice on the part of women has scarcely operated: in earlier times they were stolen or bought, and in later times mostly coerced by parents. Thus, reconsideration of the facts does not show me the invalidity of the conclusion drawn, that this decrease in size of jaw can have had no other cause than continued inheritance of those diminutions consequent on diminutions of function, implied by the use of selected and well-prepared food. Here, however, my chief purpose is to add an instance showing, even more clearly, the connexion between change of function and change of structure. This instance, allied in nature to the other, is presented by those varieties, or rather subvarieties, of dogs, which, having been household pets, and habitually fed on soft food, have not been called on to use their jaws in tearing and crunching, and have been but rarely allowed to use them in catching prey and in fighting. No inference can be drawn from the sizes of the jaws themselves, which, in these dogs, have probably been shortened mainly by selection. To get direct proof of the decrease of the muscles concerned in closing the jaws or biting, would require a series of observations very difficult to make. But it is not difficult to get indirect proof of this decrease by looking at the bony structures with which these muscles are connected. Examination of the skulls of sundry indoor dogs contained in the Museum of the College of Surgeons, proves the relative smallness of such parts. The only pug-dog's skull is that of an individual not perfectly adult; and though its traits are quite to the point they cannot with safety be taken as evidence. The skull of a toy-terrier has much restricted areas of insertion for the temporal muscles; has weak zygomatic arches; and has extremely small attachments for the masseter muscles. Still more significant is the evidence furnished by the skull of a King Charles's spaniel, which, if we allow three years to a generation, and bear in

mind that the variety must have existed before Charles the Second's reign, we may assume belongs to something approaching to the hundredth generation of these household pets. The relative breadth between the outer surfaces of the zygomatic arches is conspicuously small; the narrowness of the temporal fossæ is also striking; the zygomata are very slender; the temporal muscles have left no marks whatever, either by limiting lines or by the character of the surfaces covered; and the places of attachment for the masseter muscles are very feebly developed. At the Museum of Natural History, among skulls of dogs there is one which, though unnamed, is shown by its small size and by its teeth, to have belonged to one variety or other of lap-dogs, and which has the same traits in an equal degree with the skull just described. Here, then, we have two if not three kinds of dogs which, similarly leading protected and pampered lives, show that in the course of generations the parts concerned in clenching the jaws have dwindled. To what cause must this decrease be ascribed? Certainly not to artificial selection; for most of the modifications named make no appreciable external signs: the width across the zygomata could alone be perceived. Neither can natural selection have had anything to do with it; for even were there any struggle for existence among such dogs, it cannot be contended that any advantage in the struggle could be gained by an individual in which a decrease took place. Economy of nutrition, too, is excluded. Abundantly fed as such dogs are, the constitutional tendency is to find places where excess of absorbed nutriment may be conveniently deposited, rather than to find places where some cutting down of the supplies is practicable. Nor again can there be alleged a possible correlation between these diminutions and that shortening of the jaws which has probably resulted from selection; for in the bull-dog, which has also relatively short jaws, these structures concerned in closing them are unusually large. Thus there remains as the only conceivable cause, the diminution of size which results from diminished use. The dwindling of a little-exercised part has, by inheritance, been made more and more marked in successive generations.

Difficulties of another class may next be exemplified—those which present themselves when we ask how there can be effected by the selection of favorable variations, such changes of structure as adapt an organism to some useful action in which many different parts co-operate. None can fail to see how a simple part may, in course of generations, be greatly enlarged, if each enlargement furthers, in some decided way, maintenance of the species. It is easy to understand, too, how a complex part, as an entire limb, may be increased as a whole by the simultaneous due increase of its co-operative parts; since if, while it is growing, the channels of supply bring to the limb an unusual quantity of blood, there will naturally result a proportion-

ately greater size of all its components—bones, muscles, arteries, veins, etc. But though in cases like this, the co-operative parts forming some large complex part may be expected to vary together, nothing implies that they necessarily do so; and we have proof that in various cases, even when closely united, they do not do so. An example is furnished by those blind crabs named in the *Origin of Species* which inhabit certain dark caves of Kentucky, and which, though they have lost their eyes, have not lost the foot-stalks which carried their eyes. In describing the varieties which have been produced by pigeon-fanciers, Mr. Darwin notes the fact that along with changes in length of beak produced by selection, there have not gone proportionate changes in length of tongue. Take again the case of teeth and jaws. In mankind these have not varied together. During civilization the jaws have decreased, but the teeth have not decreased in proportion; and hence that prevalent crowding of them, often remedied in childhood by extraction of some, and in other cases causing that imperfect development which is followed by early decay. But the absence of proportionate variation in co-operative parts that are close together, and are even bound up in the same mass, is best seen in those varieties of dogs named above as illustrating the inherited effects of disuse. We see in them, as we see in the human race, that diminution in the jaws has not been accompanied by corresponding diminution in the teeth. In the catalogue of the College of Surgeons Museum, there are appended to the entry which identifies a Blenheim Spaniel's skull, the words—"the teeth are closely crowded together," and to the entry concerning the skull of a King Charles's Spaniel the words—"the teeth are closely packed, p. 3, is placed quite transversely to the axis of the skull." It is further noteworthy that in a case where there is no diminished use of the jaws, but where they have been shortened by selection, a like want of concomitant variation is manifested: the case being that of the bull-dog, in the upper jaw of which also, "the premolars . . . are excessively crowded, and placed obliquely or even transversely to the long axis of the skull."*

If, then, in cases where we can test it, we find no concomitant variation in co-operative parts that are near together—if we do not find it in parts which, though belonging to different tissues, are so closely united as teeth and jaws—if we do not find it even when the co-operative parts are not only closely united, but are formed out of the same tissue, like the crab's eye and its peduncle; what shall we say of co-operative parts which, besides being composed of different tissues, are remote from one another? Not only are we forbidden to

* It is probable that this shortening has resulted not directly but indirectly, from the selection of individuals which were noted for tenacity of hold; for the bull-dog's peculiarity in this respect seems due to relative shortness of the upper jaw, giving the under-hung structure which, involving retreat of the nostrils, enables the dog to continue breathing while holding.

assume that they vary together, but we are warranted in asserting that they can have no tendency to vary together. And what are the implications in cases where increase of a structure can be of no service unless there is concomitant increase in many distant structures, which have to join it in performing the action for which it is useful?

As far back as 1864 (*Principles of Biology*, § 166) I named in illustration an animal carrying heavy horns—the extinct Irish elk; and indicated the many changes in bones, muscles, blood-vessels, nerves, composing the fore-part of the body, which would be required to make an increment of size in such horns advantageous. Here let me take another instance—that of the giraffe: an instance which I take partly because, in the sixth edition of the *Origin of Species*, issued in 1872, Mr. Darwin has referred to this animal when effectually disposing of certain arguments urged against his hypothesis. He there says:

> "In order that an animal should acquire some structure specially and largely developed, it is almost indispensable that several other parts should be modified and co-adapted. Although every part of the body varies slightly, it does not follow that the necessary parts should always vary in the right direction and to the right degree" (p. 179).

And in the summary of the chapter, he remarks concerning the adjustments in the same quadruped, that "the prolonged use of all the parts together with inheritance will have aided in an important manner in their co-ordination" (p. 199): a remark probably having reference chiefly to the increased massiveness of the lower part of the neck; the increased size and strength of the thorax required to bear the additional burden; and the increased strength of the fore-legs required to carry the greater weight of both. But now I think that further consideration suggests the belief that the entailed modifications are much more numerous and remote than at first appears; and that the greater part of these are such as cannot be ascribed in any degree to the selection of favorable variations, but must be ascribed exclusively to the inherited effects of changed functions. Whoever has seen a giraffe gallop will long remember the sight as a ludicrous one. The reason for the strangeness of the motions is obvious. Though the fore-limbs and the hind-limbs differ so much in length, yet in galloping they have to keep pace—must take equal strides. The result is that at each stride, the angle which the hind-limbs describe round their centre of motion is much larger than the angle described by the fore-limbs. And beyond this, as an aid in equalizing the strides, the hind part of the back is at each stride bent very much downward and forward. Hence the hind-quarters appear to be doing nearly all the work. Now a moment's observation shows that the bones and muscles composing the hind-quarters of the giraffe, perform actions differing in one or other way and degree, from the actions performed by the homologous bones and muscles in a mammal of ordinary proportions,

and from those in the ancestral mammal which gave origin to the giraffe. Each further stage of that growth which produced the large fore-quarters and neck, entailed some adapted change in sundry of the numerous parts composing the hind-quarters; since any failure in the adjustment of their respective strengths would entail some defect in speed and consequent loss of life when chased. It needs but to remember how, when continuing to walk with a blistered foot, the taking of steps in such a modified way as to diminish pressure on the sore point, soon produces aching of muscles which are called into unusual action, to see that over-straining of any one of the muscles of the giraffe's hind-quarters might quickly incapacitate the animal when putting out all its powers to escape; and to be a few yards behind others would cause death. Hence if we are debarred from assuming that co-operative parts vary together even when adjacent and closely united—if we are still more debarred from assuming that with increased length of fore-legs or of neck, there will go an appropriate change in any one muscle or bone in the hind-quarters; how entirely out of the question it is to assume that there will simultaneously take place the appropriate changes in *all* those many components of the hind-quarters which severally require re-adjustment. It is useless to reply that an increment of length in the fore-legs or neck might be retained and transmitted to posterity, waiting an appropriate variation in a particular bone or muscle in the hind-quarters, which, being made, would allow of a further increment. For besides the fact that until this secondary variation occurred the primary variation would be a disadvantage often fatal; and besides the fact that before such an appropriate secondary variation might be expected in the course of generations to occur, the primary variation would have died out; there is the fact that the appropriate variation of one bone or muscle in the hind-quarters would be useless without appropriate variations of all the rest—some in this way and some in that—a number of appropriate variations which it is impossible to suppose.

Nor is this all. Far more numerous appropriate variations would be indirectly necessitated. The immense change in the ratio of fore-quarters to hind-quarters would make requisite a corresponding change of ratio in the appliances carrying on the nutrition of the two. The entire vascular system, arterial and veinous, would have to undergo successive unbuildings and rebuildings to make its channels everywhere adequate to the local requirements; since any want of adjustment in the blood-supply in this or that set of muscles, would entail incapacity, failure of speed, and loss of life. Moreover, the nerves supplying the various sets of muscles would have to be proportionately changed; as well as the central nervous tracts from which they issued. Can we suppose that all these appropriate changes, too, would be step by step simultaneously made by fortunate spontaneous variations, occurring along with all the other fortunate spontaneous varia-

tions? Considering how immense must be the number of these required changes, added to the changes above enumerated, the chances against any adequate re-adjustments fortuitously arising must be infinity to one.

If the effects of use and disuse of parts are inheritable, then any change in the fore parts of the giraffe which affects the action of the hind-limbs and back, will simultaneously cause, by the greater or less exercise of it, a re-moulding of each component in the hind-limbs and back in a way adapted to the new demands; and generation after generation the entire structure of the hind-quarters will be progressively fitted to the changed structure of the fore-quarters: all the appliances for nutrition and innervation being at the same time progressively fitted to both. But in the absence of this inheritance of functionally-produced modifications, there is no seeing how the required re-adjustments can be made.

Yet a third class of difficulties stands in the way of the belief that the natural selection of useful variations is the sole factor of organic evolution. This class of difficulties, already pointed out in § 166 of the *Principles of Biology*, I cannot more clearly set forth than in the words there used. Hence I may perhaps be excused for here quoting them:

"Where the life is comparatively simple, or where surrounding circumstances render some one function supremely important, the survival of the fittest may readily bring about the appropriate structural change, without any aid from the transmission of functionally-acquired modifications. But in proportion as the life grows complex—in proportion as a healthy existence cannot be secured by a large endowment of some one power, but demands many powers; in the same proportion do there arise obstacles to the increase of any particular power, by "the preservation of favored races in the struggle for life." As fast as the faculties are multiplied, so fast does it become possible for the several members of a species to have various kinds of superiorities over one another. While one saves its life by higher speed, another does the like by clearer vision, another by keener scent, another by quicker hearing, another by greater strength, another by unusual power of enduring cold or hunger, another by special sagacity, another by special timidity, another by special courage; and others by other bodily and mental attributes. Now it is unquestionably true that, other things equal, each of these attributes, giving its possessor an extra chance of life, is likely to be transmitted to posterity. But there seems no reason to suppose that it will be increased in subsequent generations by natural selection. That it may be thus increased, the individuals not possessing more than average endowments of it, must be more frequently killed off than individuals highly endowed with it; and this can happen only when the attribute is one of greater importance, for the time being, than most of the other attributes. If those members of the species which have but ordinary shares of it, nevertheless survive by virtue of other superiorities which they severally possess; then it is not easy to see how this particular attribute can be developed by natural selection in subsequent generations. The probability seems rather to be, that by gamogenesis, this extra en-

dowment will, on the average, be diminished in posterity—just serving in the long run to compensate the deficient endowments of other individuals, whose special powers lie in other directions; and so to keep up the normal structure of the species. The working out of the process is here somewhat difficult to follow; but it appears to me that as fast as the number of bodily and mental faculties increases, and as fast as the maintenance of life comes to depend less on the amount of any one, and more on the combined action of all; so fast does the production of specialities of character by natural selection alone, become difficult. Particularly does this seem to be so with a species so multitudinous in its powers as mankind; and above all does it seem to be so with such of the human powers as have but minor shares in aiding the struggle for life—the æsthetic faculties, for example."

Dwelling for a moment on this last illustration of the class of difficulties described, let us ask how we are to interpret the development of the musical faculty. I will not enlarge on the family antecedents of the great composers. I will merely suggest the inquiry whether the greater powers possessed by Beethoven and Mozart, by Weber and Rossini, than by their fathers, were not due in larger measure to the inherited effects of daily exercise of the musical faculty by their fathers, than to inheritance, with increase, of spontaneous variations; and whether the diffused musical powers of the Bach clan, culminating in those of Johann Sebastian, did not result in part from constant practice; but I will raise the more general question—How came there that endowment of musical faculty which characterizes modern Europeans at large, as compared with their remote ancestors? The monotonous chants of low savages cannot be said to show any melodic inspiration; and it is not evident that an individual savage who had a little more musical perception than the rest, would derive any such advantage in the maintenance of life as would secure the spread of his superiority by inheritance of the variation. And then what are we to say of harmony? We cannot suppose that the appreciation of this, which is relatively modern, can have arisen by descent from the men in whom successive variations increased the appreciation of it—the composers and musical performers; for on the whole, these have been men whose worldly prosperity was not such as enabled them to rear many children inheriting their special traits. Even if we count the illegitimate ones, the survivors of these added to the survivors of the legitimate ones, can hardly be held to have yielded more than average numbers of descendants; and those who inherited their special traits have not often been thereby so aided in the struggle for existence as to further the spread of such traits. Rather the tendency seems to have been the reverse.

Since the above passage was written, I have found in the second volume of *Animals and Plants under Domestication*, a remark made by Mr. Darwin, practically implying that among creatures which depend for their lives on the efficiency of numerous powers, the increase

of any one by the natural selection of a variation is necessarily difficult. Here it is:

"Finally, as indefinite and almost illimitable variability is the usual result of domestication and cultivation, with the same part or organ varying in different individuals in different or even in directly opposite ways; and as the same variation, if strongly pronounced, usually recurs only after long intervals of time, any particular variation would generally be lost by crossing, reversion, and the accidental destruction of the varying individuals, unless carefully preserved by man."—Vol. ii, 292.

Remembering that mankind, subject as they are to this domestication and cultivation, are not, like domesticated animals, under an agency which picks out and preserves particular variations; it results that there must usually be among them, under the influence of natural selection alone, a continual disappearance of any useful variations of particular faculties which may arise. Only in cases of variations which are specially preservative, as, for example, great cunning during a relatively barbarous state, can we expect increase from natural selection alone. We cannot suppose that minor traits, exemplified among others by the æsthetic perceptions, can have been evolved by natural selection. But if there is inheritance of functionally-produced modifications of structure, evolution of such minor traits is no longer inexplicable.

Two remarks made by Mr. Darwin have implications from which the same general conclusion must, I think, be drawn. Speaking of the variability of animals and plants under domestication, he says:

"Changes of any kind in the conditions of life, even extremely slight changes, often suffice to cause variability. . . . Animals and plants continue to be variable for an immense period after their first domestication; . . . In the course of time they can be habituated to certain changes, so as to become less variable; . . . There is good evidence that the power of changed conditions accumulates; so that two, three, or more generations must be exposed to new conditions before any effect is visible. . . . Some variations are induced by the direct action of the surrounding conditions on the whole organization, or on certain parts alone, and other variations are induced indirectly through the reproductive system being affected in the same manner as is so common with organic beings when removed from their natural conditions."—(*Animals and Plants under Domestication*, vol. ii, 270.)

There are to be recognized two modes of this effect produced by changed conditions on the reproductive system, and consequently on offspring. Simple arrest of development is one. But beyond the variations of offspring arising from imperfectly-developed reproductive systems in parents—variations which must be ordinarily in the nature of imperfections—there are others due to a changed balance of functions caused by changed conditions. The fact noted by Mr. Darwin in the above passage, that "the power of changed conditions ac-

cumulates; so that two, three, or more generations must be exposed to new conditions before any effect is visible," implies that during these generations there is going on some change of constitution consequent on the changed proportions and relations of the functions. I will not dwell on the implication, which seems tolerably clear, that this change must consist of such modifications of organs as adapt them to their changed functions; and that if the influence of changed conditions "accumulates," it must be through the inheritance of such modifications. Nor will I press the question—What is the nature of the effect registered in the reproductive elements, and which is subsequently manifested by variations?—Is it an effect entirely irrelevant to the new requirements of the variety?—Or is it an effect which makes the variety less fit for the new requirements?—Or is it an effect which makes it more fit for the new requirements? But not pressing these questions, it suffices to point out the necessary implication that changed functions of organs *do*, in some way or other, register themselves in changed proclivities of the reproductive elements. In face of these facts it cannot be denied that the modified action of a part produces an inheritable effect—be the nature of that effect what it may.

The second of the remarks above adverted to as made by Mr. Darwin, is contained in his sections dealing with correlated variations. In the *Origin of Species*, p. 114, he says:

> "The whole organization is so tied together during its growth and development, that when slight variations in any one part occur, and are accumulated through natural selection, other parts become modified."

And a parallel statement contained in *Animals and Plants under Domestication*, vol. ii, p. 320, runs thus:

> "Correlated variation is an important subject for us; for when one part is modified through continued selection, either by man or under nature, other parts of the organization will be unavoidably modified. From this correlation it apparently follows that, with our domesticated animals and plants, varieties rarely or never differ from each other by some single character alone."

By what process does a changed part modify other parts? By modifying their functions in some way or degree, seems the necessary answer. It is indeed, imaginable, that where the part changed is some dermal appendage which, becoming larger, has abstracted more of the needful material from the general stock, the effect may consist simply in diminishing the amount of this material available for other dermal appendages, leading to diminution of some or all of them, and may fail to affect in appreciable ways the rest of the organism: save perhaps the blood-vessels near the enlarged appendage. But where the part is an active one—a limb, or viscus, or any organ which constantly demands blood, produces waste matter, secretes, or absorbs—then all the other active organs become implicated in the change. The functions

performed by them have to constitute a moving equilibrium; and the function of one cannot, by alteration of the structure performing it, be modified in degree or kind, without modifying the functions of the rest—some appreciably and others inappreciably, according to the directness or indirectness of their relations. Of such inter-dependent changes, the normal ones are naturally inconspicuous; but those which are partially or completely abnormal, sufficiently carry home the general truth. Thus, unusual cerebral excitement affects the excretion through the kidneys in quantity or quality or both. Strong emotions of disagreeable kinds check or arrest the flow of bile. A considerable obstacle to the circulation offered by some important structure in a diseased or disordered state, throwing more strain upon the heart, causes hypertrophy of its muscular walls; and this change which is, so far as concerns the primary evil, a remedial one, often entails mischiefs in other organs. "Apoplexy and palsy, in a scarcely credible number of cases, are directly dependent on hypertropic enlargement of the heart." And in other cases, asthma, dropsy, and epilepsy are caused. Now if a result of this inter-dependence as seen in the individual organism, is that a local modification of one part produces, by changing their functions, correlative modifications of other parts, then the question here to be put is—Are these correlative modifications, when of a kind falling within normal limits, inheritable or not? If they are inheritable, then the fact stated by Mr. Darwin that "when one part is modified through continued selection," "other parts of the organization will be unavoidably modified" is perfectly intelligible: these entailed secondary modifications are transmitted *pari passu* with the successive modifications produced by selection. But what if they are not inheritable? Then these secondary modifications caused in the individual, not being transmitted to descendants, the descendants must commence life with organizations out of balance, and with each increment of change in the part affected by selection, their organizations must get more out of balance—must have larger and larger amounts of re-organization to be made during their lives. Hence the constitution of the variety must become more and more unworkable.

The only imaginable alternative is that the re-adjustments are effected in course of time by natural selection. But, in the first place, as we find no proof of concomitant variation among directly co-operative parts which are closely united, there cannot be assumed any concomitant variation among parts which are both indirectly co-operative and far from one another. And, in the second place, before all the many required re-adjustments could be made, the variety would die out from defective constitution. Even were there no such difficulty, we should still have to entertain a strange group of propositions, which would stand as follows: 1. Change in one part entails, by reaction on the organism, changes, in other parts, the functions of which are necessarily changed. 2. Such changes worked in the individual, affect,

in some way, the reproductive elements: these being found to evolve unusual structures when the constitutional balance has been continuously disturbed. 3. But the changes in the reproductive elements thus caused, are not such as represent these functionally-produced changes: the modifications conveyed to offspring are irrelevant to these various modifications functionally produced in the organs of the parents. 4. Nevertheless, while the balance of functions cannot be re-established through inheritance of the effects of disturbed functions on structures, wrought throughout the individual organism; it can be re-established by the inheritance of fortuitous variations which occur in all the affected organs without reference to these changes of function.

Now without saying that acceptance of this group of propositions is impossible, we may certainly say that it is not easy.

"But where are the direct proofs that inheritance of functionally-produced modifications takes place?" is a question which will be put by those who have committed themselves to the current exclusive interpretation. "Grant that there are difficulties; still, before the transmitted effects of use and disuse can be legitimately assigned in explanation of them, we must have good evidence that the effects of use and disuse *are* transmitted."

Before dealing directly with this demurrer, let me deal with it indirectly, by pointing out that the lack of recognized evidence may be accounted for without assuming that there is not plenty of it. Inattention and reluctant attention lead to the ignoring of facts which really exist in abundance; as is well illustrated in the case of pre-historic implements. Biassed by the current belief that no traces of man were to be found on the Earth's surface, save in certain superficial formations of very recent date, geologists and anthropologists not only neglected to seek such traces, but for a long time continued to pooh-pooh those who said they had found them. When M. Boucher de Perthes at length succeeded in drawing the eyes of scientific men to the flint implements discovered by him in the quaternary deposits of the Somme valley; and when geologists and anthropologists had thus been convinced that evidences of human existence were to be found in formations of considerable age, and thereafter began to search for them; they found plenty of them all over the world. Or again, to take an instance closely germane to the matter, we may recall the fact that the contemptuous attitude toward the hypothesis of organic evolution which naturalists in general maintained before the publication of Mr. Darwin's work, prevented them from seeing the multitudinous facts by which it is supported. Similarly, it is very possible that their alienation from the belief that there is a transmission of those changes of structure which are produced by changes of action, makes naturalists slight the evidence which supports that belief and refuse to occupy themselves in seeking further evidence.

If it be asked how it happens that there have been recorded multitudinous instances of variations fortuitously arising and reappearing in offspring, while there have not been recorded instances of the transmission of changes functionally produced, there are three replies. The first is that changes of the one class are many of them conspicuous, while those of the other class are nearly all inconspicuous. If a child is born with six fingers, the anomaly is not simply obvious but so startling as to attract much notice; and if this child, growing up, has six-fingered descendants, everybody in the locality hears of it. A pigeon with specially-colored feathers, or one distinguished by a broadened and upraised tail, or by a protuberance of the neck, draws attention by its oddness; and if in its young the trait is repeated, occasionally with increase, the fact is remarked, and there follows the thought of establishing the peculiarity by selection. A lamb disabled from leaping by the shortness of its legs, could not fail to be observed; and the fact that its offspring were similarly short-legged, and had a consequent inability to get over fences, would inevitably become widely known. Similarly with plants. That this flower had an extra number of petals, that that was unusually symmetrical, and that another differed considerably in color from the average of its kind, would be easily seen by an observant gardener; and the suspicion that such anomalies are inheritable having arisen, experiments leading to further proofs that they are so, would frequently be made. But it is not thus with functionally-produced modifications. The seats of these are in nearly all cases the muscular, osseous, and nervous systems, and the viscera—parts which are either entirely hidden or greatly obscured. Modification in a nervous centre is inaccessible to vision; bones may be considerably altered in size or shape without attention being drawn to them; and, covered with thick coats as are most of the animals open to continuous observation, the increases or decreases in muscles must be great before they become externally perceptible.

A further important difference between the two inquiries is that to ascertain whether a fortuitous variation is inheritable, needs merely a little attention to the selection of individuals and the observation of offspring; while to ascertain whether there is inheritance of a functionally-produced modification, it is requisite to make arrangements which demand the greater or smaller exercise of some part or parts; and it is difficult in many cases to find such arrangements, troublesome to maintain them even for one generation, and still more through successive generations.

Nor is this all. There exist stimuli to inquiry in the one case which do not exist in the other. The money-interest and the interest of the fancier, acting now separately and now together, have prompted multitudinous individuals to make experiments which have brought out clear evidence that fortuitous variations are inherited. The cattle-breeders who profit by producing certain shapes and qualities; the

keepers of pet animals who take pride in the perfections of those they have bred; the florists, professional and amateur, who obtain new varieties and take prizes; form a body of men who furnish naturalists with countless of the required proofs. But there is no such body of men, led either by pecuniary interest or the interest of a hobby, to ascertain by experiments whether the effects of use and disuse are inheritable.

Thus, then, there are amply sufficient reasons why there is a great deal of direct evidence in the one case and but little in the other—such little being that which comes out incidentally. Let us look at what there is of it.

Considerable weight attaches to a fact which Brown-Séquard discovered, quite by accident, in the course of his researches. He found that certain artificially-produced lesions of the nervous system, so small even as a section of the sciatic nerve, left, after healing, an increasing excitability which ended in liability to epilepsy; and there afterward came out the unlooked-for result that the offspring of guinea-pigs which had thus acquired an epileptic habit such that a pinch on the neck would produce a fit, inherited an epileptic habit of like kind. It has, indeed, been since alleged that guinea-pigs tend to epilepsy, and that phenomena of the kind described occur where there have been no antecedents like those in Brown-Séquard's case. But considering the improbability that the phenomena observed by him happened to be nothing more than phenomena which occasionally arise naturally, we may, until there is good proof to the contrary, assign some value to his results.

Evidence not of this directly experimental kind, but nevertheless of considerable weight, is furnished by other nervous disorders. There is proof enough that insanity admits of being induced by circumstances which, in one or other way, derange the nervous functions—excesses of this or that kind; and no one questions the accepted belief that insanity is inheritable. Is it alleged that the insanity which is inheritable is that which spontaneously arises, and that the insanity which follows some chronic perversion of functions is not inheritable? This does not seem a very reasonable allegation, and until some warrant for it is forthcoming, we may fairly assume that there is here a further support for belief in the transmission of functionally-produced changes.

Moreover, I find among physicians the belief that nervous disorders of a less severe kind are inheritable. Men who have prostrated their nervous systems by prolonged overwork or in some other way, have children more or less prone to nervousness. It matters not what may be the form of inheritance—whether it be of a brain in some way imperfect, or of a deficient blood-supply; it is in any case the inheritance of functionally-modified structures.

Verification of the reasons above given for the paucity of this direct evidence is yielded by contemplation of it, for it is observable that the cases named are cases which, from one or other cause, have thrust themselves on observation. They justify the suspicion that it is not because such cases are rare that many of them cannot be cited, but simply because they are mostly unobtrusive, and to be found only by that deliberate search which nobody makes. I say nobody, but I am wrong. Successful search has been made by one whose competence as an observer is beyond question, and whose testimony is less liable than that of all others to any bias toward the conclusion that such inheritance takes place. I refer to the author of the *Origin of Species.*

Now-a-days most naturalists are more Darwinian than Mr. Darwin himself. I do not mean that their beliefs in organic evolution are more decided; though I shall be supposed to mean this by the mass of readers, who identify Mr. Darwin's great contribution to the theory of organic evolution, with the theory of organic evolution itself, and even with the theory of evolution at large. But I mean that the particular factor which he first recognized as having played so immense a part in organic evolution, has come to be regarded by his followers as the sole factor, though it was not so regarded by him. It is true that he apparently rejected altogether the causal agencies alleged by earlier inquirers. In the Historical Sketch prefixed to the later editions of his *Origin of Species* (p. xiv, note), he writes:—"It is curious how largely my grandfather, Dr. Erasmus Darwin, anticipated the views and erroneous grounds of opinion of Lamarck in his 'Zoonomia' (vol. i, pp. 500–510), published in 1794." And since, among the views thus referred to, was the view that changes of structure in organisms arise by the inheritance of functionally-produced changes, Mr. Darwin seems, by the above sentence, to have implied his disbelief in such inheritance. But he did not mean to imply this; for his belief in it as a cause of evolution, if not an important cause, is proved by many passages in his works. In the first chapter of the *Origin of Species* (p. 11 of the first edition), he says respecting the inherited effects of habit, that "with animals the increased use or disuse of parts has had a marked influence;" and he gives as instances the changed relative weights of the wing bones and leg bones of the wild duck and the domestic duck, "the great and inherited development of the udders in cows and goats," and the drooping ears of various domestic animals. Here are other passages taken from the latest edition of the work.

"I think there can be no doubt that use in our domestic animals has strengthened and enlarged certain parts, and disuse diminished them; and that such modifications are inherited" (p. 108). [And on the following pages he gives five further examples of such effects.] "Habit in producing constitutional peculiarities and use in strengthening and disuse in weakening and diminishing organs,

appear in many cases to have been potent in their effects" (p. 131). "When discussing special cases, Mr. Mivart passes over the effects of the increased use and disuse of parts, which I have always maintained to be highly important, and have treated in my 'Variation under Domestication' at greater length than, as I believe, any other writer" (p. 176). "Disuse, on the other hand, will account for the less developed condition of the whole inferior half of the body, including the lateral fins" (p. 188). "I may give another instance of a structure which apparently owes its origin exclusively to use or habit" (p. 188). "It appears probable that disuse has been the main agent in rendering organs rudimentary" (pp. 400–401). "On the whole, we may conclude that habit, or use and disuse, have, in some cases, played a considerable part in the modification of the constitution and structure; but that the effects have often been largely combined with, and sometimes overmastered by, the natural selection of innate variations" (p. 114).

In his subsequent work, *The Variation of Animals and Plants under Domestication*, where he goes into full detail, Mr. Darwin gives more numerous illustrations of the inherited effects of use and disuse. The following are some of the cases, quoted from volume i of the first edition:

Treating of domesticated rabbits, he says:—"the want of exercise has apparently modified the proportional length of the limbs in comparison with the body" (p. 116). "We thus see that the most important and complicated organ [the brain] in the whole organization is subject to the law of decrease in size from disuse" (p. 129). He remarks that in birds of the oceanic islands "not persecuted by any enemies, the reduction of their wings has probably been caused by gradual disuse." After comparing one of these, the water-hen of Tristan d'Acunha, with the European water-hen, and showing that all the bones concerned in flight are smaller, he adds—"Hence in the skeleton of this natural species nearly the same changes have occurred, only carried a little further, as with our domestic ducks, and in this latter case I presume no one will dispute that they have resulted from the lessened use of the wings and the increased use of the legs" (pp. 286–7). "As with other long-domesticated animals, the instincts of the silk-moth have suffered. The caterpillars, when placed on a mulberry-tree, often commit the strange mistake of devouring the base of the leaf on which they are feeding, and consequently fall down; but they are capable, according to M. Robinet, of again crawling up the trunk. Even this capacity sometimes fails, for M. Martins placed some caterpillars on a tree, and those which fell were not able to remount and perished of hunger; they were even incapable of passing from leaf to leaf" (p. 304).

Here are some instances of like meaning from volume ii.

"In many cases there is reason to believe that the lessened use of various organs has affected the corresponding parts in the offspring. But there is no good evidence that this ever follows in the course of a single generation. . . . Our domestic fowls, ducks, and geese have almost lost, not only in the individual but in the race, their power of flight; for we do not see a chicken, when frightened, take flight like a young pheasant. . . . With domestic pigeons, the length of the sternum, the prominence of its crest, the length of the scapulæ and furcula, the length of the wings as measured from tip to tip of the radius,

are all reduced relatively to the same parts in the wild pigeon." [After detailing kindred diminutions in fowls and ducks, Mr. Darwin adds] "The decreased weight and size of the bones, in the foregoing cases, is probably the indirect result of the reaction of the weakened muscles on the bones" (pp. 297–8). "Nathusius has shown that, with the improved races of the pig, the shortened legs and snout, the form of the articular condyles of the occiput, and the position of the jaws with the upper canine teeth projecting in a most anomalous manner in front of the lower canines, may be attributed to these parts not having been fully exercised. . . . These modifications of structure, which are all strictly inherited, characterize several improved breeds, so that they cannot have been derived from any single domestic or wild stock. With respect to cattle, Professor Tanner has remarked that the lungs and liver in the improved breeds 'are found to be considerably reduced in size when compared with those possessed by animals having perfect liberty;' . . . The cause of the reduced lungs in highly-bred animals which take little exercise is obvious" (pp. 299–300). [And on pp. 301, 302, and 303, he gives facts showing the effects of use and disuse in changing, among domestic animals, the characters of the ears, the lengths of the intestines, and, in various ways, the natures of the instincts.]

But Mr. Darwin's admission, or rather his assertion, that the inheritance of functionally-produced modifications has been a factor in organic evolution, is made clear not by these passages alone and by kindred ones. It is made clearer still by a passage in the preface to the second edition of his *Descent of Man*. He there protests against that current version of his views in which this factor makes no appearance. The passage is as follows:

"I may take this opportunity of remarking that my critics frequently assume that I attribute all changes of corporeal structure and mental power exclusively to the natural selection of such variations as are often called spontaneous; whereas, even in the first edition of the 'Origin of Species,' I distinctly stated that great weight must be attributed to the inherited effects of use and disuse, with respect both to the body and mind."

Nor is this all. There is evidence that Mr. Darwin's belief in the efficiency of this factor, became stronger as he grew older and accumulated more evidence. The first of the extracts above given, taken from the sixth edition of the *Origin of Species*, runs thus:

"I think there can be no doubt that use in our domestic animals has strengthened and enlarged certain parts, and disuse diminished them; and that such modifications are inherited."

Now on turning to the first edition, p. 134, it will be found that instead of the words—"I think there can be no doubt," the words originally used were—"I think there can be *little* doubt." That this deliberate erasure of a qualifying word and substitution of a word implying unqualified belief, was due to a more decided recognition of a factor originally under-estimated, is clearly implied by the wording of the above-quoted passage from the preface to the *Descent of Man*; where he says that "*even* in the first edition of the 'Origin of Species,'" etc.: the implication being that much more in subsequent editions, and sub-

sequent works, had he insisted on this factor. The change thus indicated is especially significant as having occurred at a time of life when the natural tendency is toward fixity of opinion.

During that earlier period when he was discovering the multitudinous cases in which his own hypothesis afforded solutions, and simultaneously observing how utterly futile in these multitudinous cases was the hypothesis propounded by his grandfather and Lamarck, Mr. Darwin was, not unnaturally, almost betrayed into the belief that the one is all-sufficient and the other inoperative. But in the mind of one so candid and ever open to more evidence, there naturally came a reaction. The inheritance of functionally-produced modifications, which, judging by the passage quoted above concerning the views of these earlier inquirers, would seem to have been at one time denied, but which as we have seen was always to some extent recognized, came to be recognized more and more, and deliberately included as a factor of importance.

Of this reaction displayed in the later writings of Mr. Darwin, let us now ask—Has it not to be carried further? Was the share in organic evolution which Mr. Darwin latterly assigned to the transmission of modifications caused by use and disuse, its due share? Consideration of the groups of evidences given above, will, I think, lead us to believe that its share has been much larger than he supposed even in his later days.

There is first the implication yielded by extensive classes of phenomena which remain inexplicable in the absence of this factor. If, as we see, co-operative parts do not vary together, even when few and close together, and may not therefore be assumed to do so when many and remote, we cannot account for those innumerable changes in organization which are implied when, for advantageous use of some modified part, many other parts which join it in action have to be modified.

Further, as increasing complexity of structure, accompanying increasing complexity of life, implies increasing number of faculties, of which each one conduces to preservation of self or descendants; and as the various individuals of a species, severally requiring something like the normal amounts of all these, may individually profit, here by an unusual amount of one, and there by an unusual amount of another; it follows that as the number of faculties becomes greater, it becomes more difficult for any one to be further developed by natural selection. Only where increase of some one is *predominantly* advantageous does the means seem adequate to the end. Especially in the case of powers which do not subserve self-preservation in appreciable degrees, does development by natural selection appear impracticable.

It is a fact recognized by Mr. Darwin, that where, by selection through successive generations, a part has been increased or decreased,

its reaction upon other parts entails changes in them. This reaction is effected through the changes of function involved. If the changes of structure produced by such changes of function, are inheritable, then the re-adjustment of parts throughout the organism, taking place generation after generation, maintains an approximate balance; but if not, then generation after generation the organism must get more and more out of gear, and tend to become unworkable.

Further, as it is proved that change in the balance of functions registers its effects on the reproductive elements, we have to choose between the alternatives that the registered effects are irrelevant to the particular modifications which the organism has undergone, or that they are such as tend to produce repetitions of these modifications. The last of these alternatives makes the facts comprehensible; but the first of them not only leaves us with several unsolved problems, but is incongruous with the general truth that by reproduction, ancestral traits, down to minute details, are transmitted.

Though, in the absence of pecuniary interests and the interests in hobbies, no such special experiments as those which have established the inheritance or fortuitous variations have been made to ascertain whether functionally-produced modifications are inherited; yet certain apparent instances of such inheritance have forced themselves on observation without being sought for. In addition to other indications of a less conspicuous kind, is the one I have given above—the fact that the apparatus for tearing and mastication has decreased with decrease of its function, alike in civilized man and in some varieties of dogs which lead protected and pampered lives. Of the numerous cases named by Mr. Darwin, it is observable that they are yielded not by one class of parts only, but by most if not all classes—by the dermal system, the muscular system, the osseous system, the nervous system, the viscera; and that among parts liable to be functionally modified, the most numerous observed cases of inheritance are furnished by those which admit of preservation and easy comparison—the bones: these cases, moreover, being specially significant as showing how, in sundry unallied species, parallel changes of structure have occurred along with parallel changes of habit.

What, then, shall we say of the general implication? Are we to stop short with the admission that inheritance of functionally-produced modifications takes place only in cases in which there is evidence of it? May we properly assume that these many instances of changes of structure caused by changes of function, occurring in various tissues and various organs, are merely special and exceptional instances having no general significance? Shall we suppose that though the evidence which already exists has come to light without aid from a body of inquirers, there would be no great increase were due attention devoted to the collection of evidence? This is, I think, not a reasonable supposition. To me the *ensemble* of the facts suggests the belief,

scarcely to be resisted, that the inheritance of functionally-produced modifications takes place universally. Looking at physiological phenomena as conforming to physical principles, it is difficult to conceive that a changed play of organic forces which in many cases of different kinds produces an inherited change of structure, does not do this in all cases. The implication, very strong I think, is that the action of every organ produces on it a reaction which, usually not altering its rate of nutrition, sometimes leaves it with diminished nutrition consequent on diminished action, and at other times increases its nutrition in proportion to its increased action; that while generating a modified *consensus* of functions and of structures, the activities are at the same time impressing this modified *consensus* on the sperm-cells and germ-cells whence future individuals are to be produced; and that in ways mostly too small to be identified, but occasionally in more conspicuous ways and in the course of generations, the resulting modifications of one or other kind show themselves. Further, it seems to me that as there are certain extensive classes of phenomena which are inexplicable if we assume the inheritance of fortuitous variations to be the sole factor, but which become at once explicable if we admit the inheritance of functionally-produced changes, we are justified in concluding that this inheritance of functionally-produced changes has been not simply a co-operating factor in organic evolution, but has been a co-operating factor without which organic evolution, in its higher forms at any rate, could never have taken place.

Be this or be it not a warrantable conclusion, there is, I think, good reason for a provisional acceptance of the hypothesis that the effects of use and disuse are inheritable; and for a methodic pursuit of inquiries with the view of either establishing it or disproving it. It seems scarcely reasonable to accept without clear demonstration, the belief that while a trivial difference of structure arising spontaneously is transmissible, a massive difference of structure, maintained generation after generation by change of function, leaves no trace in posterity. Considering that unquestionably the modification of structure by function is a *vera causa*, in so far as concerns the individual; and considering the number of facts which so competent an observer as Mr. Darwin regarded as evidence that transmission of such modifications takes place in particular cases; the hypothesis that such transmission takes place in conformity with a general law, holding of all active structures, should, I think, be regarded as at least a good working hypothesis.

But now supposing the broad conclusion above drawn to be granted—supposing all to agree that from the beginning, along with inheritance of useful variations fortuitously arising, there has been inheritance of effects produced by use and disuse; do there remain no classes of organic phenomena unaccounted for? To this question I

think it must be replied that there do remain classes of organic phenomena unaccounted for. It may, I believe, be shown that certain cardinal traits of animals and plants at large are still unexplained; and that a further factor must be recognized. To show this, however, will require another paper.

BOTANY AS A RECREATION FOR INVALIDS.

By Miss E. F. ANDREWS.

IN a recent number of "The Popular Science Monthly," the writer of an interesting article, on "Thomasville as a Winter Resort," mentions the want of public amusements there as a subject of regret from a hygienic point of view. The criticism is a just one, and unfortunately applies to most of our Southern health resorts—St. Augustine, with its yacht club and sea-bathing, and Jacksonville, with a few other cities large enough to attract theatrical companies, forming possible exceptions.

Invalids, as a rule, have a great deal of leisure on their hands—more of it than they like—and to fill this time pleasantly is a question involving a good deal more than mere amusement. The importance of mental distraction to invalids is a fact too universally recognized to call for comment here, my object in this paper being merely to suggest a mode of distraction that, in my own experience, has not only been attended with the happiest results physically, but has proved a source of intense and never-failing pleasure. I allude to the study of botany—not the tiresome, profitless study of text-books, but of the woods, and fields, and meadows.

The beauty of this pursuit is that it takes the student out-of-doors, and throat and lung troubles, as has been truly said, are house-diseases. I am speaking, of course, to those who have begun to fight the enemy before he has captured the inner defenses, and who are supposed to be strong enough to do a reasonable amount of walking, and some solid thinking. For botany, though the simplest of the sciences, can not be mastered without some effort. You are met right at the threshold by that fearful, technical vocabulary which must be conquered before advancing a single step—a labor so formidable and repellent, when undertaken according to the old school-book method, that I do not wonder so many have shrunk away from it in disgust or in despair.

But even this task, apparently as formidable as learning a new tongue, can be made a pastime if rightly undertaken. Don't try to learn definitions or commit long strings of names to memory from a book, but get some simple work and take it out into the woods with you. Don't worry with writing schedules or trying to draw outlines

of the different kinds of leaves, but gather as many as you can; then, by reference to the book, describe them to yourself in botanical terms, and keep on in this way till you can give a scientific description of any plant you see, without the book. In a few weeks you will find that you have mastered, almost without knowing it, the dreadful bugbear of botanical language, and got a good deal of solid pleasure out of the process to boot.

You are now ready to take up the classification of plants, and to study their habits and relationships—and this is where the real pleasure begins. Don't worry about species at first, but be satisfied for a time with referring the different plants you meet to their appropriate orders and genera; specific distinctions are often perplexing, and can be attended to later. Gray's "Manual" and Chapman's "Southern Flora" are the only hand-books you will need—the latter for Southern Georgia and Florida, the former for more northern latitudes. I have seen Northern amateurs puzzling over Gray in Florida, and wondering that they could find so few of the plants around them described there, never seeming to realize that a manual of the flora of the Northern States would not answer just as well for an almost tropical region.

Florida is a specially interesting region to the botanist on account of the peculiar forms of plant-life to be found there. I wish I had time to introduce the reader to some of my friends of the forest and jungle, though I dare say he will find it more profitable to seek them out for himself. Botanizing in Florida, however, has this drawback: the pine-lands are so poor that, for the most interesting specimens, you must go to the swamps and hummocks, at the risk of getting more malaria than plants, as I can testify to my cost. But in Southern Georgia there is no such danger. The soil of the pine-lands there is richer, and the whole earth becomes, in spring-time, an Eden of beauty and fragrance. There is no need to go into malarious places; you can hardly set your foot down anywhere without treading on flowers. At a place near the railroad, between Albany and Thomasville, I once stood and gathered seventeen different species without moving out of my tracks. The Houstonias, Atamasco lilies, and jellow jasmines, make their appearance in February, and from then on till June the most diligent collector will have had as much as he can do to keep up with the rich succession of plant-life constantly unfolding itself to view.

And, all the while that one is pursuing a delightful study, he is getting abundant exercise in the open air, without the dreary consciousness of exertion for exertion's sake. One can walk for hours on a botanical ramble without fatigue, when twenty minutes of an aimless "constitutional" would send one home fagged out in body and mind. The parlor gymnastics recommended by Mr. Youmans may have their value in some cases, but for myself the most dismal moments I have ever spent were while laboring conscientiously with

dumb-bells and Indian clubs in the name of exercise. Physical exercise, for its own sake, is intense and profitless, and often, I believe, pernicious labor. Give yourself a motive for exertion, and it then becomes exhilarating. The study of plants supplies just such a motive as invalids need. It is too useless (from a practical point of view) to be suggestive of labor, and yet so exceedingly fascinating as to make you ready to undergo any amount of labor in the prosecution of your favorite "fad." I remember once exposing myself to a terrible danger in endeavoring to get possession of a rare and (to me) new plant. I scarcely thought of the risk then, though now the bare recollection of it makes me shudder. This enthusiasm, which the science of botany awakens in all who devote themselves to it, is not its least valuable hygienic factor, for a little genuine enthusiasm will put more life into a sick body than all the drugs in the dispensary.

After all, the proof of the pudding is in the eating, and in conclusion I can only urge fellow-sufferers, who have a moderate amount of strength and patience, to try my simple prescription. As an old negro nurse once said to me anent some "doctor's stuff," "If it don't do you no good, it won't do you no harm," and will at least prove a wholesome diversion from the imbecile fancy-work, and still more imbecile gossip, that make so large a part of the daily routine of life at most resorts of health and pleasure.

THE FRENCH PROBLEM IN CANADA.

By GEORGE H. CLARKE.

THE rapid growth of the French population in the Canadian provinces and the New England States has given rise to much speculation as to the future of the race. Thoughtful men in the Dominion see in its steady increase and aggressive character elements of danger to the stability of the Confederation.

The last census returns show that over one third of the population of Canada is of French origin, while in the New England States there is a large and growing French-Canadian element, wedded to its language, religion, and traditions, and controlled to an extraordinary degree by its astute and admirably organized clergy. Quebec, though a province in a British colony, is as thoroughly French as it was before the conquest. A century and a quarter of British rule has had no effect in Anglicizing the race, or leavening it with the progressive ideas which prevail in all English-speaking communities. As the Canadian French were at the conquest, their descendants remain to this day—a race isolated and apart from all others on the continent, having little in common with their neighbors, or even with their kindred in France. While the great tide of modern progress and civili-

zation is surging everywhere else through the continent, the Province of Quebec is the one stagnant pool which is never rippled by a freshening current, and over which hangs the miasma of mediæval superstition.

The non-progressive character of French civilization on this continent is due partly to the feudal institutions introduced by the early settlers, but mainly to the concessions granted by the victors to the vanquished when Canada became a British colony. By the terms of the treaty with France, and by the Quebec Act passed by the Imperial Parliament on the eve of the struggle with the Thirteen Colonies, the French population of Canada were granted the free exercise of their religion, and were allowed to retain their language, customs, and laws. By the conquest they secured all the privileges of British citizenship, without losing any of their cherished rights and privileges. Through the prodigal liberality of the British Government, the Church of Rome became the established church of Quebec, vested with all the powers which it possessed in France in the days of the "great monarch," to collect tithes and enforce its decrees. The clergy were not slow to avail themselves of those enormous powers for their own aggrandizement, and to strengthen their influence over the people. The policy of the Church from the first, but more especially of late years, has been to isolate its people from their Protestant and English-speaking fellow-citizens. It controls all the public schools and most of the higher educational institutes in the province, and from their childhood it instructs the French Canadians to jealously guard their treaty rights —to preserve their language, their laws, and their institutions. The education of the people in the public schools consists mainly in memorizing the doctrines and dogmas of the Church, and the time which is devoted in the free schools of Ontario to acquiring secular knowledge is spent by the French children in devotional exercises. The masses of the population are kept in ignorance, while the few who can afford to attend the colleges are trained by the Jesuits. Thus the press, the bar, the bench, and the Legislature, are controlled by the pulpit.

Among their public men are some of splendid ability, but with minds narrowed by provincialism and race-prejudices, and warped by religious bigotry. Occasionally one among them ventures to express independent opinions, which subject him to the censure of the bishop of the diocese. If he repents and abandons the error of his ways, he is received back into favor; if he persists in his independence, he may expect, at the very next election, to be relegated to the obscurity of private life. Thus the control of the Church over the French population of the Province of Quebec is complete, and is constantly exercised to prevent their amalgamation with other races on the continent. Intermarriage with Protestants is sternly denounced, and early marriages are earnestly advocated from the pulpit. Their faithful obedience to their pastors in these matters is proved by the census returns.

During the one hundred and fifty years that France held possession of Canada, the population increased but slowly. In 1763, four years after the conquest, it was estimated at about 65,000. Under British rule, in one hundred and twenty-five years it has grown to about 1,500,000 in Canada, and it is estimated that there are nearly half a million of the race in the United States.

The increase of population in the Province of Quebec has, however, been attended with some disadvantage as well as profit to the Church. The system of subdividing and over-cropping farms has impoverished the soil and led to much poverty in the older communities. Adventurous colonists as the early French were, their descendants manifest little inclination to establish settlements in the wilderness. They prefer, when crowded out of their old homes on the banks of the St. Lawrence, to emigrate to the New England States, where they can obtain in the manufacturing establishments employment better suited to their taste and social instinct, and larger remuneration than can be had in their own country. This exodus became so extensive during a period of depression some seven years ago that it excited alarm in the minds of the ecclesiastical and political leaders of the province. The Quebec Legislature, which is practically controlled by the clergy, and the Dominion Parliament, in which they hold the balance of power, voted large sums to repatriate the self-exiled population, but their efforts were attended with anything but gratifying results.

About that time the Province of Manitoba, which had been partly colonized by the French prior to the purchase of the Hudson Bay Territories by the Dominion, was thrown open to settlement by the establishment of railway communication with the Red River Valley. A determined effort was made by the French-Canadian leaders to convert this land of promise into another Quebec, in which the French language, French laws and customs, and the Roman Catholic religion, should prevail. With that end in view, through the influence of Sir George Cartier, Manitoba was originally made a small province, in which the French half-breeds had a large majority. To wean them from their nomadic habits, and to give them an influence altogether disproportionate to their numbers and intelligence, they and their children were granted extensive tracts of land in the Red River Valley, and large inducements were held out to the French Canadians in the United States to locate lands and settle in the neighborhood of their Metis kindred. Some were persuaded to repatriate themselves and assist in carrying out the designs of their leaders, but the vast majority preferred to remain in the manufacturing towns of New England.

From Ontario a steady stream of settlers flowed into Manitoba, and, in a very short time, the hopes of Quebec were blighted. The French element was swamped by the flood from Ontario. The control of the province passed into the hands of the Ontarians, the bounda-

ries of the province were enlarged, and Manitoba, instead of becoming a second Quebec, promises to be a new and greater Ontario.

Balked in their design to capture the great Northwest, the French-Canadian leaders turned their attention to the easier task of "freezing out" the small English-speaking element in Quebec. The population of British origin, outside of Montreal, was principally in the Eastern Townships and in the counties north of the Ottawa River, and formed about one sixth of the whole. The French Canadians were offered inducements to settle on the wild lands in the Eastern Townships. Considerable numbers were in this way led to return to their native land. Wherever an English-speaking farmer was found willing to part with his property, a French-Canadian purchaser was always at hand to secure it. Where English-speaking owners of unpatented lands had failed to comply with any of the numerous conditions of settlement, their lots were confiscated, no refund was made of the purchase-money or compensation allowed for improvements, and they were resold to French Canadians.

This policy, although inaugurated but three or four years before the census of 1881 was taken, had such a marked effect that the returns attracted attention and excited much comment throughout the Dominion. While the entire population of the Province of Quebec had increased slightly, but steadily, during the decade, the English-speaking population had remained almost stationary, and the disproportion between the two races had become more marked. And this had occurred in face of the fact that there had been a large exodus of the French population, not only to the New England States, but also to East Ontario, where they filled up the gaps made by the movement of the Ontario farmers to the Northwest. The English-speaking population are being steadily rooted out, and their places filled by settlers of French origin. Not content with wresting Quebec from the conqueror, the French Canadians are spreading into New Brunswick on the east and Ontario on the west. In the latter province they control two counties already, and will soon have majorities in two others; and it is only a question of time when they will have possession of the capital of the Dominion, a consummation which the French-Canadian members of the Dominion Cabinet are endeavoring to hasten by filling every vacancy in the civil service, so far as they can, with their countrymen.

The rapid increase and aggressiveness of the French-Canadian race, coupled with their determination to hold themselves aloof from the other sections of the population, have led thoughtful men to despair of the future of the Dominion. The hope that the confederation of the provinces would bring about a fusion of the races must have died out of the breasts of the most sanguine who have watched the agitation in Quebec over the Northwest rebellion and the execution of Riel. The French throughout the Dominion have, with few exceptions, made the cause of the rebel half-breeds their own, and exalted their mer-

cenary leader into a national hero and a martyr. Their public men, casting aside all party ties and patriotic considerations, have formed themselves into a provincial party whose object is to avenge the death of the late rebel leader, and to give to Quebec, by their united action, a predominant influence in the Parliament of the Dominion. That their unpatriotic stand will lead to a coalition of the English-speaking majority no one who is aware of the violence of party feeling in Canada will expect, and the only hope, in the opinion of many, of preserving the Dominion from the disaster of French domination lies in the success of the Government party in the next appeal to the country, or in annexation to the United States.

The facts which are above set forth have caused many of the leaders of public opinion in Canada to take a pessimistic view of the future of the Dominion. But there are, on the other side, indications that a brighter destiny awaits the Confederation.

The self-exiled Quebecers in the New England States, though followed to their new homes and carefully advised and guarded by their clergy, come in contact with a population which, bred under republican institutions, has always manifested a manly independence in spiritual as well as in temporal matters. The *habitant* never loses his love for his native land, but residence in the Great Republic brightens his intelligence and gives him a more exalted idea of his importance as an individual, and a sense of independence which is wholly foreign to the character of his countrymen at home. These men revisit their native province from time to time, carrying with them their new and advanced ideas, and thus they are leavening the masses in Quebec. Railways penetrate localities which, until recently, were as isolated from the rest of the continent as if they had been situated in the heart of China. Visitors from the outside world, who know not the *curé* and ignore the clergy generally, find their way into the most remote hamlets, carrying with them new ideas of life. Even the schools, though employed by the clergy more to prevent the spread of knowledge than to impart instruction, by teaching the youth of the country to read, enable them, when the opportunity occurs, to enlighten their minds by tasting the forbidden fruits of literature proscribed by the Church. The growth of public intelligence is necessarily slow, opposed as it is by the most powerful organization the world has ever known, but every year some slight advance is made, and to a corresponding extent the power of the Church is diminished.

When freed from ecclesiastical tyranny, the French race in Quebec possess native ability and qualities which will make them a valuable element in the population of the continent. Their industry, economy, frugality, and docility, their power of imitation, and their disinclination to become citizens of the United States, have led their enemies to brand them as the "Chinese of the East"; but, with those valuable characteristics of the Celestial, they combine others which will place

them, when emancipated from the thralldom of the Church, abreast of the most enlightened and progressive nations of the world. When that time comes, they will cease to be regarded as a burden upon the Dominion and a barrier to its progress. They will be recognized as equals, in every sense of the word, of their brethren of British origin, and their rapid increase will be viewed as a benefit rather than a disaster to the Dominion.

It is difficult to understand why the growth of the French-Canadian people should excite misgivings in the minds of the statesmen of Canada. The French race outside of Quebec has increased but slowly. It has never been successful in colonizing. In France itself the growth of the population is exceptionally slow; in the colonies of the republic the progress is even less. While Canada was a colony of France, owing to frequent wars and the exactions of the seigniors and the Church, the population in a century and a half had reached only 65,000; it is only since they have been emancipated from feudal serfdom and enjoyed the blessings of free institutions that they have developed any marked power of reproduction. In one hundred and twenty years under British rule they have increased to nearly 2,000,000, and this rapid increase has been aided little if any by immigration from France. It is due almost entirely to natural increase, and to natural increase it must be restricted in the future.

The growth of the French population on this continent has been rapid, but not phenomenal. It bears no comparison with the extraordinary expansion of the Anglo-Saxon race, even in the Dominion of Canada. Quebec had a population of 100,000, and there was a French colony on the east side of the Detroit River before there were any English-speaking inhabitants in Ontario, where they now number nearly 2,000,000. With all the advantages of a start of a century and a half, the French in Ontario do not exceed 120,000, and in the entire Dominion not over 1,500,000, out of a total of 4,500,000. Until the western movement of the Ontario farmers, some eight years ago, the spread of the French race in Ontario was almost unnoticed. It was confined almost exclusively to laborers employed by lumbering firms in their mills and in the woods, a fluctuating population as little disposed to remain permanently away from their native land as the Chinese on the Pacific coast. While Ontario is rapidly colonizing Manitoba and the vast Northwest Territories, and filling up her waste lands at home, Quebec is making but slow progress in comparison in its work of gallicizing Ontario, and her people prefer expatriation to facing the hardships incidental to pioneer life in the inhospitable wilderness north of the St. Lawrence and the Ottawa. Of the seven provinces of the Dominion, Quebec is the only one in which they possess a controlling influence; in the others, and in the United States, they are merely hewers of wood and drawers of water for the more energetic and intelligent Anglo-Saxon.

While the only fecund branch of the Gallic race is that which inhabits Eastern Canada, the British people at home and abroad have displayed marvelous powers of expansion. Every year populous swarms leave the parent hive, yet they are scarcely missed. Despite the constant drain, the Island races in Europe double every fifty-six years and in the colonies every twenty-five years, whereas the population of France doubles only in one hundred and forty years. The French commenced the work of colonizing America at the same time as the British, yet the latter have expanded to 60,000,000, while the former are represented by a total of 2,000,000. The wonderful development of the Island races continues to follow the British flag in every quarter of the globe. In Australia, New Zealand, South Africa, and other colonies, the increase has been almost as marked as on this continent, and in strong contrast to the sterility of the French at home and in their colonies everywhere.

The capacity of the Island races to absorb foreign elements of population has been illustrated to an extraordinary degree in the United States. The surplus population of every country in Europe pours in a constant stream into the republic, bringing with it customs, languages, and ideas of government wholly different from those which prevail in the United States. Yet, in a short time, this foreign mass is assimilated. The aliens become naturalized citizens; they acquire very soon a knowledge of the prevailing language and the form of government. In a few years they are Americanized, and the second generation speak the language of the continent with the fluency of other natives, and are as thoroughly American citizens as the descendants of the Pilgrim Fathers. In Louisiana a population of French origin have found it to their advantage to adopt the English language and the customs of the people among whom their lot is cast.

There can be little doubt, therefore, that the French Canadians would long since have blended with the dominant race, to their own great benefit and the advantage of the continent, had it not been for the mistaken policy of the British Government over a century ago, and the efforts of the Church of Rome to prevent a consolidation of the people of Canada into one nationality.

In view of these facts there is yet some hope for the future of the Dominion. The diffusion of knowledge among the people, their contact with more enterprising and advanced communities, now rendered practicable by the development of railway communication, and the investigating spirit of the age which priestcraft can not wholly subdue, must sooner or later produce changes which will make of the Canadians a homogeneous population. This is a solution of the problem as desirable as the only other one that has been suggested—a continental union which would crush out at once and forever the aspirations of those who are seeking to establish a new France on the banks of the St. Lawrence.

MR. GLADSTONE AND GENESIS.

By Professor T. H. HUXLEY.

IN controversy, as in courtship, the good old rule to be off with the old before one is on with the new greatly commends itself to my sense of expediency. And, therefore, it appears to me desirable that I should preface such observations as I may have to offer upon the cloud of arguments (the relevancy of which to the issue which I had ventured to raise is not always obvious) put forth by Mr. Gladstone in the January number of this review,* by an endeavor to make clear, to such of our readers as have not had the advantage of a forensic education, the present net result of the discussion.

I am quite aware that, in undertaking this task, I run all the risks to which the man who presumes to deal judicially with his own cause is liable. But it is exactly because I do not shun that risk, but, rather, earnestly desire to be judged by him who cometh after me, provided that he has the knowledge and impartiality appropriate to a judge, that I adopt my present course.

In the article on "The Dawn of Creation and Worship,"† it will be remembered that Mr. Gladstone unreservedly commits himself to three propositions. The first is that, according to the writer of the Pentateuch, the "water-population," the "air-population," and the "land-population" of the globe were created successively, in the order named. In the second place, Mr. Gladstone authoritatively asserts that this (as part of his "fourfold order") has been "so affirmed in our time by natural science, that it may be taken as a demonstrated conclusion and established fact." In the third place, Mr. Gladstone argues that the fact of this coincidence of the Pentateuchal story with the results of modern investigation makes it "impossible to avoid the conclusion, first, that either this writer was gifted with faculties passing all human experience, or else his knowledge was divine." And, having settled to his own satisfaction that the first "branch of the alternative is truly nominal and unreal," Mr. Gladstone continues, "So stands the plea for a revelation of truth from God, a plea only to be met by questioning its possibility.

I am a simple-minded person, wholly devoid of subtlety of intellect, so that I willingly admit that there may be depths of alternative meaning in these propositions out of all soundings attainable by my poor plummet. Still, there are a good many people who suffer under a like intellectual limitation; and, for once in my life, I feel that I have the chance of attaining that position of a representative of average opinion, which appears to be the modern ideal of a leader of men,

* "Popular Science Monthly" for March, 1886. † See supplement to present number.

when I make free confession that, after turning the matter over in my mind with all the aid derived from a careful consideration of Mr. Gladstone's reply, I can not get away from my original conviction that, if Mr. Gladstone's second proposition can be shown to be not merely inaccurate, but directly contradictory of facts known to every one who is acquainted with the elements of natural science, the third proposition collapses of itself.

And it was this conviction which led me to enter upon the present discussion. I fancied that if my respected clients, the people of average opinion and capacity, could once be got distinctly to conceive that Mr. Gladstone's views as to the proper method of dealing with grave and difficult scientific and religious problems had permitted him to base a solemn "plea for a revelation of truth from God" upon an error as to a matter of fact, from which the intelligent perusal of a manual of paleontology would have saved him, I need not trouble myself to occupy their time and attention with further comments upon his contribution to apologetic literature. It is for others to judge whether I have efficiently carried out my project or not. It certainly does not count for much that I should be unable to find any flaw in my own case, but I think it counts for a good deal that Mr. Gladstone appears to have been equally unable to do so. He does, indeed, make a great parade of authorities, and I have the greatest respect for those authorities whom Mr. Gladstone mentions. If he will get them to sign a joint memorial to the effect that our present paleontological evidence proves that birds appeared before the "land-population" of terrestrial reptiles, I shall think it my duty to reconsider my position —but not till then.

It will be observed that I have cautiously used the word "appears" in referring to what seems to me to be absence of any real answer to my criticisms in Mr. Gladstone's reply. For I must honestly confess that, notwithstanding long and painful strivings after clear insight, I am still uncertain whether Mr. Gladstone's "Defense" means that the great "plea for a revelation from God" is to be left to perish in the dialectic desert, or whether it is to be withdrawn under the protection of such skirmishers as are available for covering retreat.

In particular the remarkable disquisition which covers pages 624–627 of Mr. Gladstone's last contribution has greatly exercised my mind. Socrates is reported to have said of the works of Heraclitus that he who attempted to comprehend them should be a "Delian swimmer," but that, for his part, what he could understand was so good that he was disposed to believe in the excellence of that which he found unintelligible. In endeavoring to make myself master of Mr. Gladstone's meaning in these pages, I have often been overcome by a feeling analogous to that of Socrates, but not quite the same. That which I do understand, in fact, has appeared to me so very much the reverse

of good, that I have sometimes permitted myself to doubt the value of that which I do not understand.

In this part of Mr. Gladstone's reply, in fact, I find nothing of which the bearing upon my arguments is clear to me, except that which relates to the question whether reptiles, so far as they are represented by tortoises and the great majority of lizards and snakes, which are land-animals, are creeping things in the sense of the Pentateuchal writer or not.

I have every respect for the singer of the Song of the Three Children (whoever he may have been); I desire to cast no shadow of doubt upon, but, on the contrary, marvel at, the exactness of Mr. Gladstone's information as to the considerations which "affected the method of the Mosaic writer"; nor do I venture to doubt that the inconvenient intrusion of these contemptible reptiles—"a family fallen from greatness" (p. 627), a miserable decayed aristocracy reduced to mere "skulkers about the earth" (*ibid.*)—in consequence apparently of difficulties about the occupation of land arising out of the earth-hunger of their former serfs, the mammals—into an apologetic argument, which otherwise would run quite smoothly, is in every way to be deprecated. Still, the wretched creatures stand there, importunately demanding notice; and, however different may be the practice in that contentious atmosphere with which Mr. Gladstone expresses and laments his familiarity, in the atmosphere of science it really is of no avail whatever to shut one's eyes to facts, or to try to bury them out of sight under a tumulus of rhetoric. That is my experience of "the Elysian regions of Science," wherein it is a pleasure to me to think that a man of Mr. Gladstone's intimate knowledge of English life during the last quarter of a century believes my philosophic existence to have been rounded off in unbroken equanimity.

However reprehensible, and indeed contemptible, terrestrial reptiles may be, the only question which appears to me to be relevant to my argument is whether these creatures are or are not comprised under the denomination of "everything that creepeth upon the ground."

Mr. Gladstone speaks of the author of the first chapter of Genesis as "the Mosaic writer"; I suppose, therefore, that he will admit that it is equally proper to speak of the author of Leviticus as the "Mosaic writer." Whether such a phrase would be used by any one who had an adequate conception of the assured results of modern Biblical criticism is another matter; but, at any rate, it can not be denied that Leviticus has as much claim to Mosaic authorship as Genesis. Therefore, if one wants to know the sense of a phrase used in Genesis, it will be well to see what Leviticus has to say on the matter. Hence, I commend the following extract from the eleventh chapter of Leviticus to Mr. Gladstone's serious attention:

> And these are they which are unclean unto you among the creeping things that creep upon the earth: the weasel, and the mouse, and the great lizard after

its kind, and the gecko, and the land-crocodile, and the sand-lizard, and the chameleon. These are they which are unclean to you among all that creep (v. 29–31).

The merest Sunday-school exegesis therefore suffices to prove that when the "Mosaic writer" in Genesis i, 24, speaks of "creeping things" he means to include lizards among them.

This being so, it is agreed on all hands that terrestrial lizards, and other reptiles allied to lizards, occur in the Permian strata. It is further agreed that the Triassic strata were deposited after these. Moreover, it is well known that, even if certain footprints are to be taken as unquestionable evidence of the existence of birds, they are not known to occur in rocks earlier than the Trias, while indubitable remains of birds are to be met with only much later. Hence it follows that natural science does not "affirm" the statement that birds were made on the fifth day, and "everything that creepeth on the ground" on the sixth, on which Mr. Gladstone rests his order; for, as is shown by Leviticus, the "Mosaic writer" includes lizards among his "creeping things."

Perhaps I have given myself superfluous trouble in the preceding argument, for I find that Mr. Gladstone is willing to assume (he does not say to admit) that the statement in the text of Genesis as to reptiles can not "in all points be sustained" (p. 629). But my position is that it can not be sustained in any point, so that, after all, it has perhaps been as well to go over the evidence again. And then Mr. Gladstone proceeds, as if nothing had happened, to tell us that—

> There remain great unshaken facts to be weighed. First, the fact that such a record should have been made at all.

As most peoples have their cosmogonies, this "fact" does not strike me as having much value.

> Secondly, the fact that, instead of dwelling in generalities, it has placed itself under the severe conditions of a chronological order reaching from the first *nisus* of chaotic matter to the consummated production of a fair and goodly, a furnished and a peopled world.

This "fact" can be regarded as of value only by ignoring the fact demonstrated in my previous paper, that natural science does not confirm the order asserted so far as living things are concerned; and by upsetting a fact to be brought to light presently, to wit, that, in regard to the rest of the Pentateuchal cosmogony, prudent science has very little to say one way or the other.

> Thirdly, the fact that its cosmogony seems, in the light of the nineteenth century, to draw more and more of countenance from the best natural philosophy.

I have already questioned the accuracy of this statement, and I do not observe that mere repetition adds to its value.

And, fourthly, that it has described the successive origins of the five great categories of present life with which human experience was and is conversant, in that order which geological authority confirms.

By comparison with a sentence on page 627, in which a fivefold order is substituted for the "fourfold order," on which the "plea for Revelation" was originally founded, it appears that these five categories are "plants, fishes, birds, mammals, and man," which, Mr. Gladstone affirms, "are given to us in Genesis in the order of succession in which they are also given by the latest geological authorities."

I must venture to demur to this statement. I showed, in my previous paper, that there is no reason to doubt that the term "great sea monster" (used in Genesis i, 21) includes the most conspicuous of great sea animals—namely, whales, dolphins, porpoises, manatees, and dugongs;* and, as these are indubitable mammals, it is impossible to affirm that mammals come after birds, which are said to have been created on the same day. Moreover, I pointed out that, as these Cetacea and Sirenia are certainly modified land animals, their existence implies the antecedent existence of land mammals.

Furthermore, I have to remark that the term "fishes," as used technically in zoölogy, by no means covers all the moving creatures that have life, which are bidden to "fill the waters in the seas" (Genesis i, 20–22). Marine mollusks and crustacea, echinoderms, corals, and foraminifera are not technically fishes. But they are abundant in the palæozoic rocks, ages upon ages older than those in which the first evidences of true fishes appear. And, if in a geological book Mr. Gladstone finds the quite true statement that plants appeared before fishes, it is only by a complete misunderstanding that he can be led to imagine it serves his purpose. As a matter of fact, at the present moment, it is a question whether, on the bare evidence afforded by fossils, the marine creeping thing or the marine plant has the seniority. No cautious paleontologist would express a decided opinion on the matter. But, if we are to read the Pentateuchal statement as a scientific document (and, in spite of all protests to the contrary, those who bring it into comparison with science do seek to make a scientific document of it), then, as it is quite clear that only terrestrial plants of high organization are spoken of in verses 11 and 12, no paleontologist would hesitate to say that, at present, the records of sea animal life are vastly older than those of any land-plant describable as "grass, herb yielding seed, or fruit-tree."

Thus, although, in Mr. Gladstone's "Defense," the "old order passeth into new," his case is not improved. The fivefold order is no more "affirmed in our time by natural science" to be "a demonstrated conclusion and established fact" than the fourfold order was. Natural

* Both dolphins and dugongs occur in the Red Sea, porpoises and dolphins in the Mediterranean; so that the "Mosaic writer" may well have been acquainted with them.

science appears to me to decline to have anything to do with either; they are as wrong in detail as they are mistaken in principle.

There is another change of position, the value of which is not so apparent to me as it may well seem to be to those who are unfamiliar with the subject under discussion. Mr. Gladstone discards his three groups of "water population," "air population," and "land population," and substitutes for them (1) fishes, (2) birds, (3) mammals, (4) man. Moreover, it is assumed in a note that "the higher or ordinary mammals" alone were known to the "Mosaic writer" (p. 619). No doubt it looks, at first, as if something were gained by this alteration; for, as I have just pointed out, the word "fishes" can be used in two senses, one of which has a deceptive appearance of adjustability to the "Mosaic" account. Then the inconvenient reptiles are banished out of sight; and, finally, the question of the exact meaning of "higher" and "ordinary" in the case of mammals opens up the prospect of a hopeful logomachy. But what is the good of it all in the face of Leviticus on the one hand and of paleontology on the other?

As, in my apprehension, there is not a shadow of justification for the suggestion that when the Pentateuchal writer says "fowl" he excludes bats (which, as we shall see directly, are expressly included under "fowl" in Leviticus), and as I have already shown that he demonstrably includes reptiles, as well as mammals, among the creeping things of the land, I may be permitted to spare my readers further discussion of the "fivefold order." On the whole, it is seen to be rather more inconsistent with Genesis than its fourfold predecessor.

But I have yet a fresh order to face. Mr. Gladstone (p. 624) understands "the main statements of Genesis, in successive order of time, but without any measurement of its divisions, to be as follows:

1. A period of land, anterior to all life (v. 9 and 10).
2. A period of vegetable life, anterior to animal life (v. 11 and 12).
3. A period of animal life, in the order of fishes (v. 20).
4. Another stage of animal life, in the order of birds.
5. Another, in the order of beasts (v. 24 and 25).
6. Last of all, man (v. 26 and 27)."

Mr. Gladstone then tries to find the proof of the occurrence of a similar succession in sundry excellent works on geology.

I am really grieved to be obliged to say that this third (or is it fourth?) modification of the foundation of the "plea for Revelation" originally set forth satisfies me as little as any of its predecessors.

For, in the first place, I can not accept the assertion that this order is to be found in Genesis. With respect to No. 3, for example, I hold, as I have already said, that "great sea monsters" includes the Cetacea, in which case mammals (which is what, I suppose, Mr. Gladstone means by "beasts") come in under head No. 3, and not under No. 5.

Again, "fowl" are said in Genesis to be created on the same day as

fishes; therefore I can not accept an order which makes birds succeed fishes. Once more, as it is quite certain that the term "fowl" includes the bats—for in Leviticus xi, 13–19, we read, "And these shall ye have in abomination among the fowls . . . the heron after its kind, and the hoopoe, and the bat"—it is obvious that bats are also said to have been created at stage No. 3. And as bats are mammals, and their existence obviously presupposes that of terrestrial "beasts," it is quite clear that the latter could not have first appeared as No. 5. I need not repeat my reasons for doubting whether man came "last of all."

As the latter half of Mr. Gladstone's sixfold order thus shows itself to be wholly unauthorized by, and inconsistent with, the plain language of the Pentateuch, I might decline to discuss the admissibility of its former half.

But I will add one or two remarks on this point also. Does Mr. Gladstone mean to say that in any of the works he has cited, or indeed anywhere else, he can find scientific warranty for the assertion that there was a period of land—by which I suppose he means dry land (for submerged land must needs be as old as the separate existence of the sea)—"anterior to all life"?

It may be so, or it may not be so; but where is the evidence which would justify any one in making a positive assertion on the subject? What competent paleontologist will affirm, at this present moment, that he knows anything about the period at which life originated, or will assert more than the extreme probability that such origin was a long way antecedent to any traces of life at present known? What physical geologist will affirm that he knows when dry land began to exist, or will say more than that it was probably very much earlier than any extant direct evidence of terrestrial conditions indicates?

I think I know pretty well the answers which the authorities quoted by Mr. Gladstone would give to these questions; but I leave it to them to give them if they think fit.

If I ventured to speculate on the matter at all, I should say it is by no means certain that sea is older than dry land, inasmuch as a solid terrestrial surface may very well have existed before the earth was cool enough to allow of the existence of fluid water. And in this case dry land may have existed before the sea. As to the first appearance of life, the whole argument of analogy, whatever it may be worth in such a case, is in favor of the absence of living beings until long after the hot-water seas had constituted themselves; and of the subsequent appearance of aquatic before terrestrial forms of life. But whether these "protoplasts" would, if we could examine them, be reckoned among the lowest microscopic algæ, or fungi, or among those doubtful organisms which lie in the debatable land between animals and plants, is, in my judgment, a question on which a prudent biologist will reserve his opinion.

I think that I have now disposed of those parts of Mr. Gladstone's defense in which I seem to discover a design to rescue his solemn "plea for Revelation." But a great deal of the "Proem to Genesis" remains which I would gladly pass over in silence, were such a course consistent with the respect due to so distinguished a champion of the "reconcilers."

I hope that my clients—the people of average opinions—have by this time some confidence in me; for, when I tell them that, after all, Mr. Gladstone is of opinion that the "Mosiac record" was meant to give moral and not scientific instruction to those for whom it was written, they may be disposed to think that I must be misleading them. But let them listen further to what Mr. Gladstone says in a compendious but not exactly correct statement respecting my opinions:

> He holds the writer responsible for scientific precision: I look for nothing of the kind, but assign to him a statement general, which admits exceptions; popular, which aims mainly at producing moral impression; summary, which can not but be open to more or less of criticism of detail. He thinks it is a lecture. I think it is a sermon (p. 618).

I note, incidentally, that Mr. Gladstone appears to consider that the *differentia* between a lecture and a sermon is, that the former, so far as it deals with matters of fact, may be taken seriously, as meaning exactly what it says, while a sermon may not. I have quite enough on my hands without taking up the cudgels for the clergy, who will probably find Mr. Gladstone's definition unflattering.

But I am diverging from my proper business, which is to say that I have given no ground for the ascription of these opinions, and that, as a matter of fact, I do not hold them and never have held them. It is Mr. Gladstone, and not I, who will have it that the Pentateuchal cosmogony is to be taken as science.

My belief, on the contrary, is, and long has been, that the Pentateuchal story of the creation is simply a myth. I suppose it to be an hypothesis respecting the origin of the universe which some ancient thinker found himself able to reconcile with his knowledge, or what he thought was knowledge, of the nature of things, and therefore assumed to be true. As such, I hold it to be not merely an interesting but a venerable monument of a stage in the mental progress of mankind, and I find it difficult to suppose that any one who is acquainted with the cosmogonies of other nations—and especially with those of the Egyptians and the Babylonians, with whom the Israelites were in such frequent and intimate communication—should consider it to possess either more or less scientific importance than may be allotted to these.

Mr. Gladstone's definition of a sermon permits me to suspect that he may not see much difference between that form of discourse and what I call a myth; and I hope it may be something more than the slowness of apprehension, to which I have confessed, which leads me

to imagine that a statement which is "general" but "admits exceptions," which is "popular" and "aims mainly at producing moral impression," "summary" and therefore open to "criticism of detail," amounts to a myth, or perhaps less than a myth. Put algebraically, it comes to this, $x = a + b + c$; always remembering that there is nothing to show the exact value of either a, or b, or c. It is true that a is commonly supposed to equal 10, but there are exceptions, and these may reduce it to 8, or 3, or 0; b also popularly means 10, but, being chiefly used by the algebraist as a "moral" value, you can not do much with it in the addition or subtraction of mathematical values; c also is quite "summary," and, if you go into the details of which it is made up, many of them may be wrong, and their sum total equal to 0, or even to a minus quantity.

Mr. Gladstone appears to wish that I should (1) enter upon a sort of essay competition with the author of the Pentateuchal cosmogony; (2) that I should make a further statement about some elementary facts in the history of Indian and Greek philosophy; and (3) that I should show cause for my hesitation in accepting the assertion that Genesis is supported, at any rate to the extent of the first two verses, by the nebular hypothesis.

A certain sense of humor prevents me from accepting the first invitation. I would as soon attempt to put Hamlet's soliloquy into a more scientific shape. But, if I suppose the "Mosaic writer" to be inspired, as Mr. Gladstone does, it would not be consistent with my notions of respect for the Supreme Being to imagine Him unable to frame a form of words which should accurately, or at least not inaccurately, express His own meaning. It is sometimes said that, had the statements contained in the first chapter of Genesis been scientifically true, they would have been unintelligible to ignorant people; but how is the matter mended if, being scientifically untrue, they must needs be rejected by instructed people?

With respect to the second suggestion, it would be presumptuous in me to pretend to instruct Mr. Gladstone in matters which lie as much within the province of Literature and History as in that of Science; but, if any one desirous of further knowledge will be so good as to turn to that most excellent and by no means recondite source of information, the "Encyclopædia Britannica," he will find, under the letter E, the word "Evolution," and a long article on that subject. Now, I do not recommend him to read the first half of the article; but the second half, by my friend Mr. Sully, is really very good. He will there find it said that, in some of the philosophies of ancient India, the idea of evolution is clearly expressed: "Brahma is conceived as the eternal self-existent being, which, on its material side, unfolds itself to the world by gradually condensing itself to material objects through the gradations of ether, fire, water, earth, and other elements." And again: "In the later system of emanation of Sankhya there is a more

marked approach to a materialistic doctrine of evolution." What little knowledge I have of the matter—chiefly derived from that very instructive book "Die Religion des Buddha," by C. F. Koeppen, supplemented by Hardy's interesting works—leads me to think that Mr. Sully might have spoken much more strongly as to the evolutionary character of Indian philosophy, and especially of that of the Buddhists. But the question is too large to be dealt with incidentally.

And with respect to early Greek philosophy * the seeker after additional enlightenment need go no further than the same excellent storehouse of information:

> The early Ionian physicists, including Thales, Anaximander, and Anaximenes, seek to explain the world as generated out of a primordial matter which is at the same time the universal support of things. This substance is endowed with a generative or transmutative force by virtue of which it passes into a succession of forms. They thus resemble modern evolutionists, since they regard the world, with its infinite variety of forms, as issuing from a simple mode of matter.

Further on, Mr. Sully remarks that "Heraclitus deserves a prominent place in the history of the idea of evolution," and he states, with perfect justice, that Heraclitus has foreshadowed some of the special peculiarities of Mr. Darwin's views. It is indeed a very strange circumstance that the philosophy of the great Ephesian more than adumbrates the two doctrines which have played leading parts, the one in the development of Christian dogma, the other in that of natural science. The former is the conception of the Word (λόγος) which took its Jewish shape in Alexandria, and its Christian form † in that Gospel which is usually referred to an Ephesian source of some five centuries later date; and the latter is that of the struggle for existence. The saying that "strife is father and king of all" (πόλεμος πάντων μὲν πατήρ ἐστι, πάντων δὲ βασιλεύς), ascribed to Heraclitus, would be a not inappropriate motto for the "Origin of Species."

I have referred only to Mr. Sully's article, because his authority is quite sufficient for my purpose. But the consultation of any of the more elaborate histories of Greek philosophy, such as the great work of Zeller, for example, will only bring out the same fact into still more striking prominence. I have professed no "minute acquaintance" with either Indian or Greek philosophy, but I have taken a great deal of pains to secure that such knowledge as I do possess shall be accurate and trustworthy.

In the third place, Mr. Gladstone appears to wish that I should discuss with him the question whether the nebular hypothesis is or is not confirmatory of the Pentateuchal account of the origin of things. Mr. Gladstone appears to be prepared to enter upon this campaign

* I said nothing about "the greater number of schools of Greek philosophy," as Mr. Gladstone implies that I did, but expressly spoke of the "founders of Greek philosophy."

† See Heinze, "Die Lehre vom Logos," p. 9, *et seq.*

with a light heart. I confess I am not, and my reason for this backwardness will doubtless surprise Mr. Gladstone. It is that, rather more than a quarter of a century ago (namely, in February, 1859), when it was my duty, as President of the Geological Society, to deliver the Anniversary Address,* I chose a topic which involved a very careful study of the remarkable cosmogonical speculation originally promulgated by Immanuel Kant, and subsequently by Laplace, which is now known as the nebular hypothesis. With the help of such little acquaintance with the principles of physics and astronomy as I had gained, I endeavored to obtain a clear understanding of this speculation in all its bearings. I am not sure that I succeeded; but of this I am certain, that the problems involved are very difficult, even for those who possess the intellectual discipline requisite for dealing with them. And it was this conviction that led me to express my desire to leave the discussion of the question of the asserted harmony between Genesis and the nebular hypothesis to experts in the appropriate branches of knowledge. And I think my course was a wise one; but, as Mr. Gladstone evidently does not understand how there can be any hesitation on my part, unless it arises from a conviction that he is in the right, I may go so far as to set out my difficulties.

They are of two kinds—exegetical and scientific. It appears to me that it is vain to discuss a supposed coincidence between Genesis and science, unless we have first settled, on the one hand, what Genesis says, and, on the other hand, what science says.

In the first place, I can not find any consensus among Biblical scholars as to the meaning of the words "In the beginning God created the heaven and the earth." Some say that the Hebrew word *bara*, which is translated "create," means "made out of nothing." I venture to object to that rendering, not on the ground of scholarship, but of common sense. Omnipotence itself can surely no more make something "out of" nothing than it can make a triangular circle. What is intended by "made out of nothing" appears to be "caused to come into existence," with the implication that nothing of the same kind previously existed. It is further usually assumed that "the heaven and the earth" means the material substance of the universe. Hence the "Mosaic writer" is taken to imply that, where nothing of a material nature previously existed, this substance appeared. That is perfectly conceivable, and therefore no one can deny that it may have happened. But there are other very authoritative critics who say that the ancient Israelite† who wrote the passage was not likely to have been capable of such abstract thinking, and that, as a matter of philology, *bara* is commonly used to signify the "fashioning," or

* Reprinted in "Lay Sermons, Addresses, and Reviews," 1870.

† "Ancient," doubtless, but his antiquity must not be exaggerated. For example, there is no proof that the "Mosaic" cosmogony was known to the Israelites of Solomon's time.

"forming," of that which already exists. Now, it appears to me that the scientific investigator is wholly incompetent to say anything at all about the first origin of the material universe. The whole power of his organon vanishes when he has to step beyond the chain of natural causes and effects. No form of the nebular hypothesis that I know of is necessarily connected with any view of the origination of the nebular substance. Kant's form of it expressly supposes that the nebular material from which one stellar system starts may be nothing but the disintegrated substance of a stellar and planetary system which has just come to an end. Therefore, so far as I can see, one who believes that matter has existed from all eternity has just as much right to hold the nebular hypothesis as one who believes that matter came into existence at a specified epoch. In other words, the nebular hypothesis and the creation hypothesis, up to this point, neither confirm nor oppose one another.

Next, we read in the revisers' version, in which I suppose the ultimate results of critical scholarship to be embodied: "And the earth was waste [without form, in the authorized version] and void." Most people seem to think that this phraseology intends to imply that the matter out of which the world was to be formed was a veritable "chaos" devoid of law and order. If this interpretation is correct, the nebular hypothesis can have nothing to say to it. The scientific thinker can not admit the absence of law and order, anywhere or any when, in nature. Sometimes law and order are patent and visible to our limited vision; sometimes they are hidden. But every particle of the matter of the most fantastic-looking nebula in the heavens is a realm of law and order in itself, and that it is so is the essential condition of the possibility of solar and planetary evolution from the apparent chaos.*

"Waste" is too vague a term to be worth consideration. "Without form," intelligible enough as a metaphor, if taken literally, is absurd; for a material thing existing in space must have a superficies, and if it has a superficies it has a form. The wildest streaks of mare's-tail clouds in the sky, or the most irregular heavenly nebulæ, have surely just as much form as a geometrical tetrahedron; and as for "void," how can that be void which is full of matter? As poetry, these lines are vivid and admirable; as a scientific statement, which they must be taken to be if any one is justified in comparing them with another scientific statement, they fail to convey any intelligible conception to my mind.

The account proceeds: "And darkness was upon the face of the deep." So be it; but where, then, is the likeness to the celestial nebulæ, of the existence of which we should know nothing unless

* When Jeremiah (iv, 23) says, "I beheld the earth, and, lo, it was waste and void," he certainly does not mean to imply that the form of the earth was less definite, or its substance less solid, than before.

they shone with a light of their own? "And the spirit of God moved upon the face of the waters." I have met with no form of the nebular hypothesis which involves anything analogous to this process.

I have said enough to explain some of the difficulties which arise in my mind when I try to ascertain whether there is any foundation for the contention that the statements contained in the first two verses of Genesis are supported by the nebular hypothesis. The result does not appear to me to be exactly favorable to that contention. The nebular hypothesis assumes the existence of matter having definite properties as its foundation. Whether such matter was created a few thousand years ago, or whether it has existed through an eternal series of metamorphoses of which our present universe is only the last stage, are alternatives, neither of which is scientifically untenable, and neither scientifically demonstrable. But science knows nothing of any stage in which the universe could be said, in other than a metaphorical and popular sense, to be formless or empty, or in any respect less the seat of law and order than it is now. One might as well talk of a fresh laid hen's egg being "without form and void," because the chick therein is potential and not actual, as apply such terms to the nebulous mass which contains a potential solar system.

Until some further enlightenment comes to me, then, I confess myself wholly unable to understand the way in which the nebular hypothesis is to be converted into an ally of the "Mosaic writer."*

But Mr. Gladstone informs us that Professor Dana and Professor Guyot are prepared to prove that the "first or cosmogonical portion of the Proem not only accords with but teaches the nebular hypothesis."†

* In looking through the delightful volume recently published by the Astronomer Royal for Ireland, a day or two ago, I find the following remarks on the nebular hypothesis, which I should have been glad to quote in my text if I had known them sooner:

"Nor can it be ever more than a speculation; it can not be established by observation, nor can it be proved by calculation. It is merely a conjecture, more or less plausible, but perhaps, in some degree, necessarily true, if our present laws of heat, as we understand them, admit of the extreme application here required, and if the present order of things has reigned for sufficient time without the intervention of any influence at present known to us."—"The Story of the Heavens," p. 506.

Would any prudent advocate base a plea, either for or against revelation, upon the coincidence, or want of coincidence, of the declarations of the latter with the requirements of an hypothesis thus guardedly dealt with by an astronomical expert?

† *Postscript to article on "Proem to Genesis" (published in "Popular Science Monthly" for March, 1886).*—I learn with satisfaction that in America, where the stores of geological knowledge have been so greatly enlarged, the business of the reconciler has been taken into the hands of scientists: Dr. Dana, Professor of Geology in Yale College, and Dr. Arnold Guyot, Professor of Geology and Physical Geography in New Jersey College. Both of these authorities, it appears, have adhered through a long career, and now adhere with increased confidence, to the idea of a substantial harmony between science and the Mosaic text. Professor Dana's latest tract has recently appeared in the "Bibliotheca Sacra" for April, 1885. He thinks the evidence doubtful as to the priority of birds over the low or marsupian mammals (p. 214); but strong for an abundant early

There is no one to whose authority on geological questions I am more readily disposed to bow, than that of my eminent friend Professor Dana. But I am familiar with what he has previously said on this topic in his well-known and standard work, into which, strangely enough, it does not seem to have occurred to Mr. Gladstone to look before he set out upon his present undertaking; and unless Professor Dana's latest contribution (which I have not yet met with) takes up altogether new ground, I am afraid I shall not be able to extricate myself, by its help, from my present difficulties.

It is a very long time since I began to think about the relations between modern scientifically ascertained truths and the cosmogonical speculations of the writer of Genesis; and, as I think that Mr. Gladstone might have been able to put his case with a good deal more force if he had thought it worth while to consult the last chapter of Professor Dana's admirable "Manual of Geology," so I think he might have been made aware that he was undertaking an enterprise of which he had not counted the cost, if he had chanced upon a discussion of the subject which I published in 1877.*

Finally, I should like to draw the attention of those who take interest in these topics to the weighty words of one of the most learned and moderate of Biblical critics:

À propos de cette première page de la Bible, on a coutume de nos jours de disserter, à perte de vue, sur l'accord du récit mosaïque avec les sciences naturelles; et comme celles-ci, tout éloignées qu'elles sont encore de la perfection absolue, ont rendu populaires et en quelque sorte irréfragables un certain nombre de faits généraux ou de thèses fondamentales de la cosmologie et de la géologie, c'est le texte sacré qu'on s'évertue à torturer pour le faire concorder avec ces données.†

TRANS.—[Pertinently to this first page of the Bible, it has been customary in our days to descant to an extreme on the accord of the Mosaic recital with the

plant life in the Azoic period (p. 213): and he holds, with Professor Guyot, that the first, or cosmogonical, portion of the "Proem" not only accords with, but teaches, the nebular hypothesis (p. 220).

It is a relief to find that the burden of this argument is shared with witnesses, who are competent and unsuspected on the scientific side; and who will not be liable to a repetition *mutatis mutandis* of an old objection: "*This people, which knoweth not the law, is accursed*" (St. John, vii, 49).

Mr. Marsh, Professor of Palæontology in Yale College, holds ("Ornithodontes," 1880, p. 137), on the grounds of the wide differences between the *Archæopteryx* and the other types of early birds, that the common ancestor was remote and probably Palæozoic. He also adheres to the order—1. Reptiles; 2. Birds; 3. Mammals. (It may be well to refer to Sir C. Lyell, "Principles of Geology," vol. iii, p. 175, on the reasons why bird-remains are sometimes rare.)

In my passages referring to geological results, I would ask the reader to substitute *priority* for *succession*. The latter implies a continuity of series, which is not found in the scientific record, since it is broken by the absence of reference to the invertebrates of the palæozoic, and the reptiles of the mesozoic rocks.—*W. E. G.*

* Lectures on Evolution delivered in New York. (American Addresses.)

† Reuss, "L'Histoire Sainte et la Loi," i, 275.

natural sciences; and as the latter, very far removed from absolute perfection as they still are, have rendered popular, and after a manner indisputable, a certain number of general facts or fundamental theses of cosmology and geology, it is the sacred text that they strive to torture in order to make it agree with these data.]

In my paper on the "Interpreters of Nature and the Interpreters of Genesis," while freely availing myself of the rights of a scientific critic, I endeavored to keep the expression of my views well within those bounds of courtesy which are set by self-respect and consideration for others. I am therefore glad to be favored with Mr. Gladstone's acknowledgment of the success of my efforts. I only wish that I could accept all the products of Mr. Gladstone's gracious appreciation, but there is one about which, as a matter of honesty, I hesitate. In fact, if I had expressed my meaning better than I seem to have done, I doubt if this particular proffer of Mr. Gladstone's thanks would have been made.

To my mind, whatever doctrine professes to be the result of the application of the accepted rules of inductive and deductive logic to its subject-matter, and accepts, within the limits which it sets to itself, the supremacy of reason, is science. Whether the subject-matter consists of realities or unrealities, truths or falsehoods, is quite another question. I conceive that ordinary geometry is science, by reason of its method, and I also believe that its axioms, definitions, and conclusions are all true. However, there is a geometry of four dimensions, which I also believe to be science, because its method professes to be strictly scientific. It is true that I can not conceive four dimensions in space, and therefore, for me, the whole affair is unreal. But I have known men of great intellectual powers who seemed to have no difficulty either in conceiving them, or, at any rate, in imagining how they could conceive them, and therefore four-dimensioned geometry comes under my notion of science. So I think astrology is a science, in so far as it professes to reason logically from principles established by just inductive methods. To prevent misunderstanding, perhaps I had better add that I do not believe one whit in astrology; but no more do I believe in Ptolemaic astronomy, or in the catastrophic geology of my youth, although these, in their day, claimed—and, to my mind, rightly claimed—the name of science. If nothing is to be called science but that which is exactly true from beginning to end, I am afraid there is very little science in the world outside mathematics. Among the physical sciences I do not know that any could claim more than that each is true within certain limits, so narrow that, for the present at any rate, they may be neglected. If such is the case, I do not see where the line is to be drawn between exactly true, partially true, and mainly untrue forms of science. And what I have said about the current theology at the end of my paper, leaves, I think, no doubt as to the category in which I rank it. For all that, I think it would be not

only unjust, but almost impertinent, to refuse the name of science to the "Summa" of St. Thomas or to the "Institutes" of Calvin.

In conclusion, I confess that my supposed "unjaded appetite" for the sort of controversy in which it needed not Mr. Gladstone's express declaration to tell us he is far better practiced than I am (though probably, without another express declaration, no one would have suspected that his controversial fires are burning low) is already satiated.

In "Elysium" we conduct scientific discussions in a different medium, and we are liable to threatenings of asphyxia in that "atmosphere of contention" in which Mr. Gladstone has been able to live, alert and vigorous beyond the common race of men, as if it were purest mountain air. I trust that he may long continue to seek truth, under the difficult conditions he has chosen for the search, with unabated energy—I had almost said fire:

> "May age not wither him, nor custom stale
> His infinite variety."

But Elysium suits my less robust constitution better, and I beg leave to retire thither, not sorry for my experience of the other region—no one should regret experience—but determined not to repeat it, at any rate, in reference to the "plea for Revelation."—*Nineteenth Century.*

COMMENTS BY PROFESSOR HENRY DRUMMOND.

SCIENCE, Religion, Philology, and History have now unsheathed their most richly chased blades in this famous tournament. So goodly a fight has not been seen for many a day; and whether one regards the dignity of the combatants, or the gravity and delicacy of the cause, it is not possible to await the issue without the keenest interest. Meanwhile, a voice may be permitted on behalf of a group among the spectators who have not yet been heard in this controversy, but whose modest reluctance to interfere seems only equaled by their right. In arenas more obscure, but not less worthy, they too have fought this fight; and as a humble camp-follower, and from conviction that the thing must now be done, rather than as one possessing the right to do it, I would venture to state the case on their account.

Mr. Huxley interposes in this question because he is moved by the violence being done in high places to natural science. This third party is constrained to speak because of a similar violence done to theological science. Were the reconcilers of Geology and Genesis equal in insight to their last and most distinguished champion, and did Mr. Gladstone himself realize the full meaning of his own concessions, little further contribution to this controversy might perhaps be

called for. And, were the opponents of this ancient fraternity as calm in spirit, as respectful to beliefs, and as discriminating as to the real question at issue as Mr. Huxley, no other word need be spoken. But with a phalanx of reconcilers on the one hand, who will continue to shelter untenable positions under the carefully qualified argument of Mr. Gladstone, and with quasi-scientific men on the other, who will exaggerate and misinterpret the triumph of Mr. Huxley, a further clearing of the ground is necessary. The breadth of view, the sagacity, and inimitable charity of Mr. Gladstone's second article certainly go far with many minds to remove the forebodings with which they received the first. Nevertheless, so powerful a championship of a position which many earnest students of modern religious questions have seen reason wholly to abandon can not but excite misgivings of a serious kind. And though these are now in part removed by the large concessions and ampler statement of the second paper, Mr. Gladstone still deliberately involves himself with the fortunes of the reconcilers. So far, however, is he in advance of most of them that much that may be reluctantly said here against the stand-point from which they work in no sense applies to him. This much fairness not less than courtesy makes it a pleasure to premise.

It will be recognized by every one that the true parties in this case are, as the title of Mr. Huxley's article suggests, "The Interpreters of Genesis and the Interpreters of Nature." Now, who are the interpreters of Genesis? We answer by asking, Who are the interpreters of Nature?

We respectfully point out to Mr. Huxley that his paper contains no single reference to the interpreters of Genesis in the sense in which he uses the term "the interpreters" in the case of science. Who are "the interpreters" of Nature? Mr. Huxley answers, and rightly, himself. And who are "the interpreters" of Genesis? Certainly Mr. Gladstone would be the last to claim this for himself. Does not the legitimate question lie between *modern theology* and modern science? And in perfect fairness should not the title of Mr. Huxley's paper have read, "*Some* interpreters of Genesis, and the scientific interpreters of Nature"? This may be a verbal matter, and we do not press it. But in view of the fact that many will see in Mr. Huxley's article, and in spite of all protestation, a direct and damaging assault upon the Biblical records, would it not have been right to point out the real terms of the antithesis? It may be replied, and justly, that Mr. Huxley is not responsible for the inferences of the uneducated. And in ordinary circumstances it would be gratuitous to define so carefully the real limitations of the question at issue. But the circumstances here are quite exceptional. For, although the widely general knowledge of science makes the aberrations of individual theorists in that department harmless, it is not so in the case of theology. Theology, in this relation, has long suffered under quite

unusual treatment. Any visionary is taken, and that notoriously by men of science, as the representative of the system. And it is time for theology to be relieved of the irresponsible favors of a hundred sciolists, whose guerrilla warfare has so long alienated thinking men in all departments of knowledge. That there is a "science of theology" Mr. Huxley himself admits. It has exponents in Britain and Germany as well-equipped in learning, in sobriety, in balance of mind, and in the possession of the scientific spirit, as the best of the interpreters of Nature. When these men speak of science, it is with respectful reliance upon the best and most recent authorities. They complain that when science speaks of them it accepts positions and statements from any quarter, from books which have been for years or centuries outgrown; or from popular teachers whom scientific theology unweariedly repudiates. To theological science the whole underlying theory of the reconcilers is as exploded as Bathybius. And Mr. Huxley's interference, however much they welcome it in the interest of popular theology, is to them the amusing performance of a layman, the value of which to scientific theology is about the same as would be a refutation of the Ptolemaic astronomy to modern physics.*

This, however, to some minds may have to be made plain, and we may briefly devote ourselves to a statement of the case.

The progress of opinion on this whole subject is marked by three phases: First, until the present century the first chapter of Genesis was accepted as a veritable cosmogony. This, in the circumstances, was inevitable. The hypothesis of Laplace was not yet in the field; paleontology, Fracastoro notwithstanding, had produced nothing except what every one knew was the remains of the Noachian Deluge;

* Of course, in commentaries written by experts for popular uses, the condemnatory evidence from natural science is sometimes formally cited in stating the case against the reconcilers generally. From one of the most recent, as well as most able, of these we quote the following passage, in which Mr. Huxley is anticipated in so many words. It is here seen, not only that theology "knew all this before," but how completely it has abandoned the position against which Mr. Huxley's counter-statements are directed: "This narrative is not careful to follow the actual order in which life appeared on the globe: it affirms, e. g., that fruit-trees existed before the sun was made; science can tell us of no such vegetation. It tells us that the birds were created in the fifth day, the reptiles in the sixth; Nature herself tells a different tale, and assures us that creeping things appeared before the flying fowl. But the most convincing proof of the regardlessness of scientific accuracy shown by this writer is found in the fact that in the second chapter he gives a different account from that which he has given in the first, and an account irreconcilable with physical facts. . . . He represents the creation of man as preceding the creation of the lower animals—an order which both the first chapter and physical science assure us was not the actual order observed. . . . It seems to me, therefore, a mistaken and dangerous attempt which is often made to reconcile the account of physical facts given here with that given in Nature herself. These accounts disagree in the date or distance from the present time to which the work of creation is assigned, in the length of time which the preparation of the world for man is said to have occupied, and in the order in which life is introduced into the world."—"Genesis," by Marcus Dods, D. D. Edinburgh, T. & T. Clark, 1882.

and geology, even with Buffon behind it, had so little to say for itself that a hint from the Sorbonne was sufficient to quench what feeble light it had. The genesis of the world, therefore, was left to Moses, and the most mechanical theory of creation—a purely anthropomorphic thing and not really in the sacred page at all—was everywhere accepted.

Presently, as the sciences gathered volume and focused their rays on the past, a new version of creation was spelled out from earth and sea and stars. Accepted at first tentatively, even by men of science, it is not to be wondered at that theologians were for a time unwilling to give up the reading which had held the ground so long. They therefore adopted the policy which is always followed in similar circumstances—compromise and adjustment. Thus intervened the interregnum of the reconcilers, De Luc, Kurtz, Pye-Smith, Hugh Miller, Chalmers, and a hundred others whom we need not name. The man who speaks of the labors of these workers without respect has no acquaintance with the methods by which truth, or error, is ascertained. It was necessary that that mine should be worked, and worked out. Whatever fundamental error underlay it, it was done with reverence, with courage, often with learning and with eloquence. A whole literature sprang up around the reconstruction, and one good end was at least secured—science was ardently studied by the Church. But the failure of the new method was a foregone conclusion, and those who sailed on this shallow sea one by one ran aground. This was a moment of peril—one of those moments which always come when truth is in the making, and which, honestly accepted, lead to new departures in the direction where the true light is ultimately found. The wise among the harmonists accepted the situation, though some of them did not know where next to turn. But deliverance swiftly came, and from an unlooked-for quarter.

For meantime in Germany and England, in a wholly different department of theology, another science was at work. Apart from any questions of doctrinal detail, the young science of Biblical Criticism was beginning to inquire into the composition, meaning, method, and aims of the sacred books. It dealt with these books, in the first instance, simply as literature. Questions of age, authorship, and literary form were for the first time investigated by qualified experts. And the result of these labors—labors in the truest sense scientific—is that these sacred writings are now regarded by theology from a wholly changed stand-point. Now from this stand-point the problem of the reconciliation of Genesis with geology simply disappears. The probable scientific solution, the possibility or impossibility of a harmony—the very statement becomes an absurdity. The question, in fact, is as irrelevant as that of the senior wrangler who asked what Milton's "Paradise Lost" was meant to prove. This is of course the true method of dealing with old theories. Beaten in argument, they will surely

rise again; outgrown, they are forever dead. And this is the hall-mark of all true science, that it destroys by fulfilling.

However it may have escaped recognition, it is certain that theology has been at work for some time now with methods of inquiry similar to those employed by natural science. And it has already partially succeeded in working out a reconstruction of some important departments from the stand-point of development. If the student of science will now apply to theology for its Bible, two very different books will be laid before him.

The one is the Bible as it was accepted by our forefathers; the other is the Bible of modern theology. The books, the chapters, the verses, and the words are the same in each, yet in the meaning, the interpretation, and the way in which they are looked at, they are two entirely distinct Bibles. The distinction between them is one which science will appreciate the moment it is stated. In point of fact, the one is constructed like the world according to the old cosmogonies; the other is an evolution. The one represents revelation as having been produced on the creative hypothesis, the Divine-fiat hypothesis, the ready-made hypothesis; the other on the slow-growth or evolution theory. This last—the Bible of development—is the Bible of modern scientific theology. It is not less authoritative than the first, but it is differently authoritative; not less inspired, it is yet differently inspired.

From its stand-point the Bible has not been made in a day, any more than the earth; nor have its parts been introduced mechanically into the minds of certain men, any more than the cells of their brain. In uttering it they have not spoken as mere automata—the men, though inspired, were *authors*. This Bible has not been given independently of time, of place, or of circumstance. It is not to be read without the philosophic sense which distinguishes the provisional from the eternal; the historic sense, which separates the local from the universal; or the literary sense, which recognizes prose from poetry, imagery from science. The modern Bible is a book whose parts, though not of unequal value, are seen to be of different kinds of value; where the casual is distinguished from the essential, the subordinate from the primal end. This Bible is not an oracle which has been erected; it has grown. Hence it is no longer a mere word-book, nor a compendium of doctrines, but a nursery of growing truths. It is not an even plane of proof-texts without proportion or emphasis, or light and shade, but a revelation varied as Nature, with the divine in its hidden parts, in its spirit, its tendencies, its obscurities, and its omissions. Like Nature, it has successive strata, and valley and hill-top, and mist and atmosphere, and rivers which are flowing still, and hidden ores, and here and there a place which is desert, and fossils too, whose crude forms are the stepping-stones to higher things. In a word, this Bible is like the world in which it is found, natural, human, intelligible in form; mysterious, inscrutable, divine in origin and essence.

With so living a book, theology has again become living. A whole cloud of problems, perplexities, anomalies, and doubts fall before it. No formal indictment is drawn against older views; difficulties are not examined and answered in detail. Before the new stand-point they disappear of themselves. Men who are in revolt against many creeds breathe again in this larger atmosphere and believe afresh, satisfying their reason and keeping their self-respect. For scientific theology no more pledges itself to-day to the interpretations of the Bible of a thousand years ago than does science to the interpretations of Nature in the time of Pythagoras. Nature is the same to-day as in the time of Pythagoras, and the Bible is the same to-day as a thousand years ago. But the Pythagorean interpretation of Nature is not more impossible to the modern mind than are many ancient interpretations—those of Genesis among others—to the scientific theologian.

This is no forced attempt, observe, to evade a scientific difficulty by concessions so vital as to make the loss or gain of the position of no importance. This change is not the product of any destructive criticism, nor is this transformed book in any sense a mutilated Bible. It is the natural result of the application of ordinary critical methods to documents which, sooner or later, must have submitted to the process and from which they have never claimed exemption.

But to return to Genesis. Those modern critics, believing or unbelieving, who have studied the Biblical books as literature—studied them, for instance, as Professor Dowden has studied Shakespeare—concur in pronouncing the Bible absolutely free from natural science. They find there history, poetry, moral philosophy, theology, lives and letters, mystical, devotional, and didactic pieces; but science there is none. Natural objects are, of course, repeatedly referred to, and with unsurpassed sympathy and accuracy of observation; but neither in the intention of any of the innumerable authors nor in the execution of their work is there any direct trace of scientific teaching. Could any one with any historic imagination for a moment expect that there would have been? There was no science then. Scientific questions were not even asked then. To have given men science would not only have been an anachronism, but a source of mystification and confusion all along the line. The almost painful silence—indeed, the absolute sterility—of the Bible with regard to science is so marked as to have led men to question the very beneficence of God. Why was not the use of the stars explained to navigators, or chloroform to surgeons? Why is a man left to die on the hill-side when the medicinal plant which could save him, did he but know it, lies at his feet? What is it to early man to know how the moon was made? What he wants to know is how bread is made. How fish are to be caught, fowls snared, beasts trapped and their skins tanned—these are his problems. Doubtless there are valid reasons why the Bible does not contain a technological dictionary and a pharmacopœia, or anticipate the "Encyclo-

pædia Britannica." But that it does not inform us on these practical matters is surely a valid argument why we should not expect it to instruct the world in geology. Mr. Huxley is particular to point out to us that the bat and the pterodactyl must be classified under the "winged fowl" of Genesis, while at a stretch he believes the cockroach might also be included. But we should not wonder if the narrator did not think of this.

Scientific men, apparently, need this warning, not less than those whom they punish for neglecting it. How ignorantly, often, the genius of the Bible is comprehended by those who are loudest in their denunciations of its positions otherwise, is typically illustrated in the following passage from Haeckel. Having in an earlier paragraph shown a general harmony between the Mosaic cosmogony and his own theory of creation, he proceeds to extract out of Genesis nothing less than the evolution theory, and that in its last and highest developments:

> Two great and fundamental ideas, common also to the non-miraculous theory of development, meet us in this Mosaic hypothesis of creation with surprising clearness and simplicity—the idea of separation or differentiation, and the idea of progressive development or perfecting. Although Moses looks upon the results of the great laws of organic development . . . as the direct actions of a constructing Creator, yet in his theory there lies hidden the ruling idea of a progressive development and a differentiation of the originally simple matter.*

With the next breath this interpreter of Genesis exposes "two great fundamental errors" in the same chapter of the book in which he has just discovered the most scientific phases of the evolution hypothesis, and which lead him to express for Moses "just wonder and admiration." What can be the matter with this singular book? Why is it science to Haeckel one minute and error the next? Why are Haeckel and Mr. Huxley not agreed, if it is science? Why are Haeckel and Mr. Gladstone agreed, if it is religion? If Mr. Huxley does not agree with Haeckel why does he not agree with Mr. Gladstone?

George MacDonald has an exquisite little poem called "Baby's Catechism." It occurs among his children's pieces:

> Where did you come from, baby dear?
> Out of the everywhere into here.
>
> Where did you get your eyes so blue?
> Out of the sky as I came through.
>
> Where did you get that little tear?
> I found it waiting when I got here.
>
> Where did you get that pearly ear?
> God spoke, and it came out to hear.
>
> How did they all just come to be you?
> God thought about me and so I grew.

* Haeckel, "History of Creation," vol. i, p. 88.

For its purpose what could be a finer, or even a more true, account of the matter than this? Without a word of literal truth in it, it would convey to the child's mind exactly the right impression. Now conceive of the head nurse banishing it from the nursery as calculated to mislead the children as to the origin of blue eyes. Or imagine the nursery governess who has passed the South Kensington examination in Mr. Huxley's "Physiology" informing her pupils that ears never "came out" at all, and that hearing was really done inside, by the fibers of Corti and the epithelial arrangements of the maculæ acusticæ. Is it conceivable, on the other hand, that the parish clergyman could defend the record on the ground that "the everywhere" was a philosophical presentation of the Almighty, or that "God thought about me" contained the Hegelian Idea? And yet this is precisely what interpreters of Genesis and interpreters of science do with the Bible. Genesis is a presentation of one or two great elementary truths to the childhood of the world. It can only be read aright in the spirit in which it was written, with its original purpose in view, and its original audience. What did it mean to them? What would they understand by it? What did they need to know and not to know?

To expand the constructive answers to these questions in detail does not fall within our province here. What we have to note is, that a scientific theory of the universe formed no part of the original writer's intention. Dating from the childhood of the world, written for children, and for that child-spirit in man which remains unchanged by time, it takes color and shape accordingly. Its object is purely religious, the point being, not how certain things were made, but that God made them. It is not dedicated to science, but to the soul. It is a sublime theology, given in view of ignorance or idolatry or polytheism, telling the worshipful youth of the world that the heavens and the earth and every creeping and flying thing were made by God. What world-spirit teaches men to finger its fluid numbers like a science catalogue, and discuss its days in terms of geological formations? What blindness pursues them, that they mark the things he made only with their museum-labels, and think they have exhausted its contribution when they have never even been within sight of it? This is not even atheism. It is simple illiterateness.

The first principle which must rule our reading of this book is the elementary canon of all literary criticism, which decides that any interpretation of a part of a book or of a literature must be controlled by the dominant purpose or *motif* of the whole. And, when one investigates that dominant purpose in the case of the Bible, he finds it reducing itself to one thing—religion. No matter what view is taken of the composition or authorship of the several books, this feature secures immediate and universal recognition.

Mais s'il en est ainsi (says Lenormant), me demandera-t-on peut-être, Où donc voyez-vous l'inspiration divine des écrivains qui ont fait cette archéologie, le

secours surnaturel dont, comme chrétien, vous devez les croire guidés? Où? Dans l'esprit absolument nouveau qui anime leur narration, bien que la forme en soit restée presque de tout point la même que chez les peuples voisins.*

[TRANS.—But if it is so, I may be asked, where, then, do you see the divine inspiration of the writers who made this archæology, the supernatural aid by which you, as a Christian, must believe they were guided? Where? In the absolutely new spirit that animates their narration, although the form of it may still be in almost every point the same as with the neighboring peoples.]

A second principle is expressed with such appositeness to the present purpose, by an English commentator, that his words may be given at length:

There is a principle frequently insisted on, scarcely denied by any, yet recognized with sufficient clearness by few of the advocates of revelation, which, if fully and practically recognized, would have saved themselves much perplexity and vexation, and the cause they have at heart the disgrace with which it has been covered by the futile attempts that have been made, through provisional and shifting interpretations, to reconcile the Mosaic Genesis with the rapidly advancing strides of physical science. The principle referred to is this: matters which are discoverable by human reason, and the means of investigation which God has put within the reach of man's faculties, are not the proper subjects of Divine revelation; and matters which do not concern morals, or bear on man's spiritual relations toward God, are not within the province of revealed religion.†

Here lies the whole matter. It is involved in the mere meaning of revelation, and proved by its whole expression, that its subject-matter is that which men could not find out for themselves. Men could find out the order in which the world was made. What they could not find out was, that God made it. To this day they have not found that out. Even some of the wisest of our contemporaries, after trying to find that out for half a lifetime, have been forced to give it up. Hence the true function of revelation. Nature in Genesis has no link with geology, seeks none and needs none: man has no link with biology, and misses none. What he really needs and really misses—for he can get it nowhere else—Genesis gives him; it links Nature and man with their Maker. And this is the one high sense in which Genesis can be said to be scientific. The scientific man must go there to complete his science, or it remains forever incomplete. Let him no longer resort thither to attack what is not really there. What is really there he can not attack, for he can not do without it. Nor let religion plant positions there which can only keep science out. Then only can the interpreters of Nature and the interpreters of Genesis understand each other.—*Nineteenth Century.*

* "Les Origines de l'Histoire," Préf., xviii. † Quarry, "Genesis," pp. 12, 13.

THE HAND-WORK OF SCHOOL-CHILDREN.*

By REBECCA D. RICKOFF.

AN exhibition of children's hand-work was held last spring in one of the public schools of Yonkers. The large assembly-room of the school-house was filled with lines of tables, upon which were displayed the various articles to be exhibited. The room was handsomely decorated, and the tables were daintily covered and adorned with bunches of flowers. For each class-room in the house there was set apart one or more tables upon which was placed, under the direction of the class-teacher, the work of that class, the whole presenting the appearance of a very successful and pretty fair.†

While this exhibition was given in the school-house, and under the direction of the school superintendent and teachers, with the sanction and encouragement of the school board, and though the work was done by pupils of the school only, none of the things were made in the school, excepting the colored paper busy-work of the youngest children and, of course, the drawing. All the other things were made *at home*, and expressly for this exhibition. Too much credit can not be given to the teachers who undertook and carried forward this enterprise, it being entirely outside of the regular school-work. There were many difficulties to overcome. Numbers of the children were sure they could not make anything; but, by conversations with them about what they had done or seen done, and what they would like to do, by constant encouragement to at least attempt something, and advice as to ways and means, and especially by enlisting the pride of the pupils in this, which was to be peculiarly *their* exhibition, independent of school instruction, most of the children were induced to undertake something.

The next difficulty was to prevail upon them to persevere and complete the thing commenced, many of them beginning a half-dozen things before completing one. This failing, so common to all, was well dealt with by this exhibition, in that the necessity to have an article ready by a given day forced the child to exercise his own will-power in deciding upon and completing some one thing, and thus became a good moral lesson. The greatest care was taken by the teachers to impress upon the children the credit of honest work. They were advised to consult with relatives and friends as to what

* A report upon the Yonkers Industrial Exhibition of Children's Work, read before the Committee of Industries of the Industrial Educational Association of New York.

† The exhibition here described was given in school No. 2, of which Miss Dresser is principal, to whom and to her assistant teachers great credit is due. Similar exhibitions were given the previous year, in this school and also in school No. 6, of which Miss Spencer is principal, and equal credit is due to her and her assistants.

to make and how to make it, but were honor-bound to refrain from accepting any help in the work itself; and it is believed by all interested in the exhibition that the exceptions to strict honesty and truthfulness in regard to the making of the articles were very rare.

The exhibition was open during the day and evening, and the patrons and friends of the schools came in hundreds to see it. Your committee were among the visitors, and were so deeply impressed with the importance of this exhibition in relation to the work of our Association that we determined to make a list of *the different kinds of things* exhibited, and the ages of the children who made them, with a view of forming from this list some estimate of what children can make and like to make at different stages of growth and development. It is one of the aims of this Association to form a graded system of manual training, and such data as can be obtained from exhibitions of this kind would be invaluable for that purpose. Superintendent Gorton having promised us ample facilities for making the list at another visit when the rooms would not be so crowded, we gave ourselves up to listening to the comments of the visitors; and their lively interest and intelligent appreciation of the exhibit convinced us that it needs only such exhibitions to create a public sentiment in favor of a movement in this direction. Many parents, desiring to give help and sympathy to their children in their school-work, find themselves at a disadvantage. It is seldom that even a well-educated and intelligent parent is conversant with the last new methods of the schools, and his suggestions and help, not being in accord with them, are looked upon by the children as incorrect or old-fashioned. Thus many fathers and mothers are made to feel at times that they are cut off from taking part in their children's education. But here, in this exhibition, is something that bridges the gap between home and school, something the parent knows all about—how that bread was mixed, that garment fashioned, that ladder whittled out, that little wagon painted. Not only can they understand, but they themselves were the teachers. This can become a great power for good to the community through the avenues both of the school and the home.

We subjoin a list in which are noted down only those articles most characteristic of the grade in which they were found, and in each grade the age of the children is given. There were some remarkable and elaborate toys and fancy-work showing skill, ability, even genius for invention and great application and perseverance; but these were the efforts of children having special capacities or unusual opportunities. It is, of course, a great gain to the community that those having particular aptitudes for industrial pursuits should be encouraged and cultivated; but this Association has, besides this practical aim, another which is broader and more far-reaching, and that is, to find principles by which manual training may be adapted to large classes of ordinary children. The wonderful things that remarkable children

can do show us where great successes lie, but what we most need at present are the common things showing us how and where the multitudes of children walk, or rather stumble, along. And we would here respectfully suggest the advisability of securing such lists from exhibitions of this kind that may be held in different sections of the country, to be kept among the records of this Association for reference, until we shall have obtained data sufficient to guide us in our work. In such a collection there will doubtless be much worthless material and many duplicates, but will not the suggestive facts be worth the trouble of gathering them? That a thing is many times duplicated by children of the same age will indicate it as something suited to that age; that at certain other ages the work is below the average as to number of articles, or unsuited to the growth of the children, will indicate a want of proper occupation or true development of children of that age.

Among the specimens of the work of the first year in school, by children five or six years old, we observed, in the girls' department, a doll's muff of white fur; dolls' aprons, one of silk trimmed with lace; dressed dolls; a doll's bonnet, creditably made up of scraps of fur, lace, and ribbon, and a tiny feather; a doll's apron, with high neck, long sleeves, and a yoke; a cushion and a lamp-mat in colors; coarse lace-work of different kinds; a child's apron, and a child's petticoat.

Among the most noteworthy articles in the boys' department were a boat hollowed out, with rudder and seats; a bob-sled, made by connecting two tiny sleds by a strip of board, which was fastened with two screws and nuts; a cube of wood, with a number of squares engraved on each face; bow and arrow; a ladder of thirteen steps evenly adjusted; a rake, made of two pieces of other toys, with bits of iron wire for teeth—the wood had split in the making, and was mended with screws; a screen window; a chair and table, apparently made from kindling-wood with a penknife; a wagon, made of a rough box, with ends of spools for wheels; a toy pump, quite equal to those of its kind that are sold in the shops, with spout and handle correctly inserted.

In the second school year, the children of which were six or seven years old, the boys exhibited a rake, more laboriously made, but showing less ingenuity than the rake previously mentioned; several ladders, of different patterns, but with steps of uniform length and spacing correct in all; an invention—a gun made from two triangular pieces of unplaned board, a piece of old bucket-hoop, and the top of an old pepper-box, with a little stick for a projectile; a tip-cart—a box with two old furniture-rollers for wheels, two screws, two small strips of wood to hold the tongue, and two bits of twine serving as hinges to the tail-board; a shapely keel-boat, of sharp model, with mast, sail, and pennant, standing in two supporting blocks, and the whole easily held in a lady's hand; a handsome bracket, made by a

colored boy too old for his class, who was supposed to be simple-minded. A boy who was sure he could not make anything brought a wire hanging-basket filled with wood-moss and ferns and a blossoming anemone.

The girls' work of this grade begins to show the effect of training at home, and is more conventional than that of the boys. The specimens included white undergarments, neatly made and trimmed; aprons of various styles; knitted dolls' hoods, lace and crochet work; baby's clothes, crazy-work mats, dressed dolls, bean-bags, pen-wipers, and pin-cushions.

Of the third school year, the children being seven and eight years old, the girls' work did not differ materially from that last described. In the boys' department, wheelbarrows appeared to be a specialty, but we found also saw-bucks, bedsteads, boot-jacks, a gunboat, a cross of wood mounted for wax-work, a fort, and mounted drawings; many houses, made of common pasteboard, with doors, bay-windows, dormer-windows, and porticoes; a boat, noticeable for its neat oars, and its row-locks made of black dress-eyes.

In the products of the next two years, by children from eight to ten years old, while the boys' work was still mainly confined to toys, that of the girls appeared to be growing more practical. Pride in execution was shown in both.

Boys' work: A velocipede, small but complete, with hubs, spokes, felloes, and tires represented by lines of black; a substantial and neatly finished wagon; clothes-horses, step-ladders, saw-bucks, easels, ocean-steamers, and catamarans, seemed to be favorites; several forts were exhibited; a curious vase was ingeniously made from a tomato-can, with a large black spool serving as pedestal, the whole decorated with gilt paper and bright-colored pictures.

Girls' work: Sofa-cushions, pillow-shams, aprons; a white Mother Hubbard dress; machine-work, tucking, lace, darned socks, splashers, a quilt, crazy-work, albums of stamps, and pictures.

In the sixth and seventh years, representing children from ten to fourteen years old, all the work was elaborate and well done, but was participated in by a smaller proportion of the pupils. The work of the boys was less prominent than that of the girls, but was more practical than in previous years.

The *boys' work* comprised chiefly cabinet-work (book-cases, easels, checker-boards, a table), a door-mat of coffee-sacking tufted with rope-ends.

The *girls' work* included excellent plain sewing, exemplified in children's dresses, fine aprons, and underwear; fancy-work (painted cards, embroidered banner-screens, lace, a crib-quilt, an embroidered table-scarf); bread, cakes, pickles, etc. There were many hundreds of other articles in the exhibition, a large majority of them creditable productions, and all representing earnest effort.

One of the noticeable features of the exhibition was an apparent decline in originality of invention and spontaneity of thought after the first year or two at school. Pride in the execution of good work seems to have been exhibited most prominently in the middle period. As the girls grew older and were trained in household and needle and fancy work at home, their products exhibited more variety, but not more novelty, and they continued to contribute specimens till their highest age at school. But, while some work was furnished by girls of over fourteen, very little was exhibited by boys of corresponding age. They found themselves too unskilled to make good specimens, and were too proud to exhibit poor ones. Another fact deserving notice is that, in the work of the boys during the first years of school, there were apparent a love for color and a skill in using it for decoration and design, equal to that displayed by the girls; while in the later years the use of color becomes exceptional with the boys, but still continues to prevail, with evidences of increased skill, in the work of the girls.

When a few days ago we were requested to prepare this report, Superintendent Gorton was consulted, and from him it was learned that this Yonkers experiment was of two years' growth, and that the idea originated in Mount Vernon. The first exhibition of the kind was held in the public-school house of that village nine years ago, and with the exception of two years the exhibitions have since been regularly continued. The parents and citizens have always taken great interest in them, the children have enjoyed and felt pride in them, and the teachers have cheerfully done the extra work. The present principal of the school, Mr. Charles Nichols, heartily approves them as a source of good moral influence.

As results of an investigation of this subject, your committee would sum up as advantages accruing from the exhibition of the home-work of children through the medium of the schools: A bringing together of the home and the school, thus conducing to a better acquaintance between the parents and the teachers; giving to the teacher a better knowledge of the child's home influences and surroundings, thus enabling him to exercise a more intelligent care over the development of the child's moral character; giving to the parents a better insight and new interest in the schools and their management, with an overflowing of the moral influence of school training into homes where intelligent discipline is unknown; a greatly increased respect in all quarters for handicrafts; the diffusion of the principle that in the liberal education of the individual a development of manual skill, as well as a harmonious unfolding of the mental faculties, should be looked after, and that these react favorably on each other in various ways.

The facts were made clear that some children are especially endowed with native capacity for mechanical contrivances, which needs

excitation, encouragement, and opportunity for development, in the lack of which their usefulness will be impaired for life; that some children are endowed with great capacity in this direction, while they have but little in any other; that the happiness of every family may be promoted by the disposition and ability on the part of its various members to adapt the material resources within their control to the convenience and comfort of all; that by the cultivation in early childhood of a taste for manual employment there would be found in almost every individual aptitudes for hand-work of one kind or another, which would afford pleasurable pursuits in hours not occupied with the serious affairs of life, and which would contribute to his happiness as well as promote his pecuniary welfare; that such occupations, aside from the main pursuits of life, would aid in forming good habits and good morals; that the children of the poor especially need something to occupy their time and attention out of school-hours, whereby they may be withdrawn from the demoralizing influences of the streets; that it will be wise for this Association to promote the *home industries* of children by all means in their power, one of the most effective being public exhibitions, where a comparison of the results of the industries of the children may be made; that by such exhibitions we shall not only educate the child-contributors, but that they will also educate us and the community.

THE TEETH OF THE COMING MAN.*

By OSCAR SCHMIDT.

THE alternative as to whether man was created or developed can no longer be raised, now that we are exercising the free use of our reason. Man's dentition has to be judged from our experiences made in the mammalian group. Hence, first of all, it is a reduced dentition. True, we do not know the definite stages by which it was attained in man, any more than we do in the case of the anthropomorphoids, and all the other apes of the Old World, but we shall not hesitate to maintain that the ancestors of man possessed a fuller number of teeth, as long as deductions are justified from the observation of facts. Our teeth have decreased in number during the course of our geologico-zoölogical development; we have lost on either side, above and below, two incisors, two premolars, and one molar. By this we transfer ourselves back to those periods from which the jaw of the otocyon has been preserved. Baume, our eminent odontologist, in a recent work which we have repeatedly referred to, has successfully followed and pointed out cases of atavism or reversion in the human

* From "The Mammalia in their Relation to Primeval Times." By Oscar Schmidt. New York: D. Appleton & Co., 1886.

jaw, by tracing cases of "surplus" teeth—and certain dental formations met with in the jaws in a large percentage of cases—back to those portions of the jaw in the animal ancestors of man which have disappeared in the course of ages.

If, in former times, more teeth were met with in the group which was perfecting itself into man, we must be permitted to ask—nay, we are compelled in a purely scientific spirit to ask—whether things have come to a stand-still in this part of our organization, or whether a further reduction is to be anticipated? Man is certainly one of the so-called "persistent species," but he is not unconditionally stationary. He varies as regards dentition. Imperfect as are our statistics on this point, this much is certain, that the cases of disappearance or loss of teeth most frequently concern the so-called wisdom-teeth, and then the outer incisors. We do not, of course, know how often the question has applied to the actual and complete loss of the teeth, or only to some interference with the teeth cutting the gum, occasioned by a limitation of the necessary space. However, it must be remembered that the shortening of the jaw stands in direct correlation with the reduction of the dentition. A prediction of the man of the future is given us by Cope: the lower races of men will retain the dentition of the present day, incisors $\frac{2}{2}$, canines $\frac{1}{1}$, premolars $\frac{2}{2}$, molars $\frac{3}{3}$; while the intellectually higher races will be distinguished by the dental formulas:

$$\text{incisors } \frac{\mathbf{1}}{2}, \text{ canines } \frac{1}{1}, \text{ premolars } \frac{2}{2}, \text{ molars } \frac{3}{3};$$

$$\text{and incisors } \frac{\mathbf{1}}{\mathbf{1}}, \text{ canines } \frac{1}{1}, \text{ premolars } \frac{2}{2}, \text{ molars } \frac{\mathbf{2}}{\mathbf{2}}.$$

We agree with this in so far that, as a rule, the reduction of the dentition—where the disappearance does not affect the whole set of teeth—can be brought into connection with the idea of progress, and many proofs of this have been given in the course of our discussion. Still, this higher faculty of resistance and of acquiring food is not necessarily accompanied by an increase in the power of the adaptability and a perfecting of the intellectual faculties. In the cat we have a more powerful, and hence a higher development of the nature of the rapacious animal than in the dog, with its more old-fashioned form of dentition. Yet who would think of placing cats as intellectually higher than dogs? It is the same with the prospects of the human races. Modifications in the human dentition are sure to take place—as surely as man can not rid himself of his animal ancestors, even though they may be felt to be inconvenient. But progress in the intellectual and moral domain—and here our well-founded idealism steps in—is not dependent upon the possession or the loss of our wisdom-teeth. The correlation is not wanting; but it makes itself felt in an opposite direction. The man who is engaged in making inventions and in scientific pursuits, and is advancing and encouraging all

the nobler and more refined enjoyments of life, is not improving the instruments for the acquisition of his food; they deteriorate in his hands—a condition which first began to make its appearance with the invention of cooking. The reduction of the human dentition—which has been of advantage to the species in its struggle for existence—has further increased and changed to a kind of atavism or reversion, since reason, acquired with speech, has made man more and more independent of the direct effects of his natural surroundings.

Hence it is not merely from a purely zoölogical point of view that an inference is formed regarding the future change of the human race. Moreover, we cherish the hope—which is justified by scientific experiences—and the belief, which rests upon the same foundation, and these convince us of the sure advance of humanity, and of the gradual and general diffusion of morality, culture, and well-being among the various races of man.

EARTHQUAKES IN CENTRAL AMERICA.

By M. de MONTESSUS,

of the Meteorologico-seismic observatory at San Salvador.

CENTRAL AMERICA is probably the region of the globe in which the manifestations of volcanic and seismic phenomena are most frequent and continuous. During my residence of four years at San Salvador, I have been able to write the detailed history of twenty-three hundred and thirty-two earthquakes, one hundred and thirty-seven volcanic eruptions, twenty-seven ruins of important towns, and the formation of three new volcanoes. Geographically, Central America, founded on the Cordillera of the Andes, forms a connecting link between the two great continental masses through three successive isthmuses, those of Panama or Darien, Izabal, and Tehuantepec. It descends to the Atlantic in two large wedges, ending in Capes Gracias á Dios and Catocha, and rests abruptly on the nearly rectilinear coast of the Pacific. The base of the Cordillera is of primitive formation, and its western flank, with which we are concerned, is formed of Miocene and Pliocene strata, terminating with Quaternary and modern alluvions and more or less recent volcanic flows.

Parallel with this axis runs the remarkable string of volcanoes which, from Chiriqui in the State of Panama, to Soconusco in Mexico, includes not less than one hundred and forty-three volcanic mountains or craters, thirty of which are active, or have been within the three hundred and sixty-three years that separate us from the Spanish Conquest. They do not present themselves, as is generally believed, upon a straight line or along a volcanic fault, nor even on a line broken at

two or three points, but in a zone having borders parallel to the Pacific coast, with an average width of about thirty miles. This formation arises from the fact that Central America has had three successive shores, recording as many periods of least movement in the increase of the Cordillera, to each of which corresponds a line of contemporaneous volcanoes. The most ancient shore was of the Miocene period, when a system of trachytic and basaltic eruptions took place; then in the Pliocene rose the chain of the largest number of extinct volcanoes; while in the Quaternary and modern periods appeared the line of existing volcanoes and of others that have since become extinct. It is apparent, then, that the volcanic force has always been near the shore of the ocean, and has moved successively from the east to the west, so as to be at only a short distance from it, as the Cordilleras in their progressive elevation carried the shore farther in that direction. These views, incontestable to me, are plainly read on the strata of the country.

The system of volcanoes is completed by a chain of lakes alternating with them. The principal lakes are those of Managua and of the roads of Fonseca, the latter of which has been put in communication with the ocean by means of some volcanic convulsion. The roads of Nicoya and Chiriqui seem to me to be of the same origin. This part of the system is surely one of the most remarkable aggregations of lakes and volcanoes in the world, and strikingly reminds us, but on a grander scale, of that of the lakes of Limagne, Issoire, and Brassac, with the chain of the *puys* of Auvergne, which would correspond with the chain of the Marrabios. Starting at the roads of Fonseca, the chain of lakes and volcanoes continues, the former diminishing in importance, to San Salvador and Guatemala. I am not speaking of the numerous picturesque crater-lakes which we meet everywhere in Central America, and which I regard as an accident of no particular importance.

A phenomenon well worthy of attention may be observed at the foot of the chain of volcanoes near Ahuachapan, in San Salvador, in the Ausales, some three or four hundred conical tunnels scattered over a space of about three square leagues, their diameters varying from three or four metres to thirty or thirty-five metres, from which occur, at short intervals, eruptions of vapors, boiling water, and argillaceous mud of many colors. They are grouped by dozens very close together, and poison the plain with their acid and sulphurous emanations. The ground around them resounds under the feet of the traveler, but only along lines which seem to be immediately over the subterranean channels through which the hot water and gases circulate.

From this multiplicity of volcanoes it results that the ground presents a complicated net-work of ancient and modern lava-flows, crossing one another, volcanic alluvions, beds of cinders and tufas, "bad lands," and an extraordinary thermal activity. There also follows a remarkable frequency of earthquakes and subterranean noises, called

retumbos. I estimate the average number of shocks felt annually in Central America at two hundred and fifty. Several conclusions may be drawn from the study of the twenty-three hundred and thirty-two earthquakes that have been registered since the conquest. First, contrary to the opinion generally prevailing from Chili to Mexico, the tremors occur about alike through the whole year, and not principally at the transitions between the rainy and dry seasons. But, to perceive this clearly, it is necessary to leave out of the account some series of earthquakes that mask the truth, such as that of December, 1879, at San Salvador, in which more than seven hundred shocks occurred in ten days, and which was the prelude to the appearance of a new volcano in the center of Lake Ilopango. With this precaution, a tendency to equality may be observed between the several months, and I am satisfied that a term of four years will be sufficient to make this equality plain. The same may be said of the *retumbos.* The maximum of eruptions appears to occur in July. Kluge puts it in August for the whole globe. The coincidence which the same author has predicated between the maxima of auroræ boreales and sun-spots and of volcanic and seismic manifestations has not been historically verified in Central America. The minute study of twenty years of observations at the Institute of Guatemala and my own observations at San Salvador have proved to me that, if the movements of the crust of the earth are connected with those of the barometer, the law of the relation is deeply hidden. I do not deny it, but I have observed nothing analogous to what Scrope believes he has established for Stromboli, and Waltershausen for Etna. Earthquakes and *retumbos* are apparently more frequent at night than in the daytime. I say apparently, because it may be that manifestations, quite perceptible in the stillness of the night, pass unobserved amid the bustle of the day. From what I have seen, I think I can affirm that the signs of terror given by domestic animals are more marked the longer the shock lasts, and that without reference to its intensity.

While I do not think that it is possible in the present state of knowledge to predict earthquakes, I believe that the phenomena are frequently connected with an indefinable aggregation of atmospheric conditions which, subjected to many years of study, might lead to the discovery of some law. This is so true that persons who have lived long in the country often say when they meet, without knowing why, "There will be an earthquake to-day"; and they are seldom mistaken. Towns in Central America, situated near active volcanoes, have much less to fear than those which, being in the dangerous zone, are more distant from them. This may be proved by the local history. Guatemala was destroyed seven times, between 1541 and 1773, while it was near the extinct volcano of Agua; but it has not suffered since 1775, when it was removed to its present position near the active volcano of Fuego, of which forty-four eruptions have taken place. Izalco, built

on the flanks of Izalco, a volcano which has had since its formation in 1770 an eruption about every twenty minutes and twenty-one considerable ones, has never been destroyed, nor have Santa Anna, San Miguel, and Masaya, on the slopes of the volcanoes of the same names, which have had respectively seven, ten, and six great eruptions. San Salvador, which is built on the slopes of Quetzaltepec, has been wholly destroyed fourteen times, the last time on the 19th of March, 1873. This volcano may be regarded as extinct, for it has had only one eruption since the conquest, that of the 30th of September, 1659, when the cinders flew as far as Comayagua, the capital of Honduras, and the lavas formed the immense "bad land" (*cheyre*) of Quetzaltepec and buried the Indian city of Nejapa. The principal of the eight craters of Quetzaltepec (or San Salvador as it is otherwise called) is remarkable for its perfect regularity and its size, six hundred metres in diameter and depth. The bottom is occupied by an almost inaccessible lake. The appearance of the volcano of Lake Ilopango, in 1879–'80, probably saved San Salvador from a fifteenth destruction. Omoa and Jucuapa, built on the slopes of the extinct volcanoes of the same names, were destroyed on the 4th of August, 1856, and the 2d of October, 1878.

In a work published by the Government of San Salvador on "Earthquakes and Volcanic Eruptions in Central America," in which I have given a detailed history of the phenomena, I have been able to show, from original documents, that the destruction of Guatemala, on the night of the 10th and 11th of September, 1541, was due, not to an eruption of mud from the extinct volcano of Agua, as some authors suppose, but to the rupture under the weight of the water, assisted by an earthquake, of the walls of its crater, which had been filled by the extraordinary rains of the preceding days. The eruption of Pacaya, on the 18th of February, 1651, and the ruin of Guatemala, which it occasioned, were accompanied by the spectacle of frightened wild animals seeming to seek the protection of man, as they did also during the eruption of Coseguina on the 20th of January, 1835. The year 1770 witnessed the rise of Izalco—"the Lighthouse of the Pacific"—a magnificent volcano, whose eruptions have since followed one another uninterruptedly about every quarter of an hour, with explosions that are frequently heard for ten leagues around. The great eruption of Coseguina, on the 20th, 21st, 22d, and 23d of January, 1835, perhaps one of the most formidable eruptions mentioned in history, the cinders from which flew as far as to Vera Cruz, Havana, Carácas, and Bogotá, was heard over the same circle of seventeen hundred miles in diameter. The well-proved coincidence that these eruptions began on the same day with those of the Chilian volcanoes of Aconcagua and Corcovado, all three situated in the chain of the Andes, is too remarkable not to attract attention. The environs of the active volcano of Momotombo from the 1st to the 20th of April, 1850, witnessed the emergence of the new volcano of Las Pilas, now extinct.

A fact remarked by Humboldt as accompanying the earthquake of the 4th of November, 1799, at Cumana, was also observed at Guatemala on the 8th of December, 1859. I refer to a sudden and considerable deviation of the magnetic needle, which still continues. To account for it, I propose the theory of a change by the shock in the disposition of the neighboring strata.

A series of more than seven hundred shocks between the 20th and 31st of December, 1879, two of which were disastrous, and which caused much alarm at San Salvador, was the prelude to the appearance, in the neighboring Lake of Ilopango, of a new but ephemeral volcano, whose mass caused the lake to overflow its banks and to produce a terrible inundation in the valley of the Rio Jiboa. The event has been made the subject of a detailed and very interesting study by Messrs. Goodyear and Rockstroh. I will only observe respecting it that two hundred and thirty-seven explosions took place on the 4th of March, 1880, between twenty-five minutes past nine and twenty minutes past ten in the morning, and eight hundred and ninety-seven explosions between eighteen minutes past seven in the evening of the following day and seventeen minutes past three on the next morning.

The *retumbos* heard at San Salvador and in Colombia on the 27th of August, 1883, were doubtless the echo of the eruption of Krakatoa. I am satisfied that if such a work as I have performed for the small fraction of Central America were done for the whole system of the Cordilleras, from Cape Horn to Behring Strait, and if the different governments would establish meteorologico-seismic observatories, like the one I have directed for four years at San Salvador, it would be possible, in this home of volcanic activity, to form some sound theory of these interesting and terrible phenomena, and perhaps to find some means of announcing them beforehand, as we predict storms on the Atlantic.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE GEMS OF THE NATIONAL MUSEUM.

By GEORGE F. KUNZ.

THE collection of gems exhibited by the National Museum at the Cincinnati and New Orleans Expositions is now on exhibition at the rooms of the Museum in Washington. This much-needed accession, representing a small part of the appropriation for the World's Fair, promises to be one of the most attractive and instructive features of the museum. The large number of visitors who examined the collection, both at the fairs and in its present location, can testify to its interesting character. Although a mere beginning, it is the most complete public collection of gems in the United States. It is contained in two

flat plate-glass exhibition-cases, the gems being neatly marked with printed labels, and arranged on velvet pads with a silk-rope border. The diversity, brilliance, and richness of Nature's brightest colors displayed render the whole effect a very attractive and pleasing one. The collection begins with a suite of glass models of the historical diamonds, followed by a series of diamonds in their natural state, among which is an interesting octahedron, eighteen carats in weight.* These specimens are good illustrations of the form from South Africa, though of little commercial value as gems. One dozen other crystals from one quarter to one carat in weight complete a representative set of form and occurrence in that region. Next we have a very neat set of a dozen more crystals, small but choice, principally from India and Brazil, and formerly belonging to the Mallet collection. One of these is a perfect cube, a form peculiar to Brazil, while another is twinned parallel to the octahedron. Another stone of one carat is only half cut, and for comparison we have a stone of about the same weight completely cut.

Among the sapphires we find a carat, oblong stone of dark-blue color, from the Jenks mine, Macon County, North Carolina, which has yielded a few fair sapphires, yellow, violet, and blue, and a few rubies, some of the finest of which were in the Leidy collection; also the first stones found here, the dark-brown, asteriated sapphires, described in "Transactions of the New York Academy of Sciences," March, 1883, and two other cut stones weighing from four to eight carats. These all show a slight bronze play of light on the dome of the cabochon in ordinary light, but under artificial light they all show well-defined stars, being really asterias or star-sapphires, and not cat's-eyes, as would seem at first glance. There are also two cut stones, light blue and light green, weighing one and two carats respectively, which, for light-colored sapphires, are perhaps, when cut, brighter than those from any other locality. The cutting of one of these gems has given it a remarkable luster. They are found in the sluice-boxes at and near Helena, Montana. Following are two broken crystals of the dark-green sapphires from the quite recent find at the Hills of Precious Stones in Siam, beautifully dichroitic, being green and blue when viewed in different axes. An asteria of good blue color, measuring nearly one inch across, a beautiful two-carat ruby-asteria, and a small three-quarter-carat ruby, of fair color, complete the corundum gems.

* Gems are generally bought and sold by the weight, called a *carat*, which is equal to about 3·168 troy grains. It is usually divided, however, into four diamond or pearl grains, each of which is ·7925 of a true grain. Fractions of a carat are also known as fourths, eighths, sixteenths, thirty-seconds, and sixty-fourths. The weight of the carat formerly differed slightly in different countries, and this diversity finally led a syndicate of Parisian jewelers, goldsmiths, and gem-dealers, in 1871, to propose a standard *carat*. This was subsequently confirmed by an arrangement between the diamond-merchants of London, Paris, and Amsterdam, fixing the uniform value of the *diamond* (?) carat at ·205 grain.

The series of spinels is well chosen and varicolored: it consists of a long two-carat stone of smoky-blue color; an oblong almandine-colored stone of three carats, an inky stone of one and a half carat, a half-carat ruby spinel of fair color, a pretty rubicelle of three quarters of a carat, and a suite of crystals of the ruby-colored spinel from Ceylon and Burmah. We have also a cut Alexandrite (so called after the Czar Alexander I), from the original Russian locality. This is of fair color, but the wonderful Ceylonese gems of recent years have really given to this phenomenal variety of chrysoberyl, which changes from green to red under artificial light, its present high rank among gems. There is a six-carat typical chrysoberyl, finely cut (the chrysolite of the jeweler), truly, as the name indicates, golden beryl, and a dark-green one of that shade repeatedly sold as Alexandrite, though it does not change color by artificial light. A set of seven rough fragments from Brazil is instructive by comparison.

Among the beryls we have a flawed emerald of ten carats, that well illustrates the typical color, as does a pear-shaped drop of about the same weight and quality. There is also a crystal that has been in the institution for many years, labeled from New Mexico. It is evidently not from that locality, for no other such occurrence is on record, and we must suspect that the label is a misnomer, since the crystal has unmistakable signs of Muso (New Granada) origin. An emerald crystal two inches long, one of a series of minerals brought by Professor J. D. Dana from Peru when with the Wilkes Exploring Expedition, is historically interesting. It was purchased by him in the streets of Callao. In the same series are two good cut beryls, one six carats in weight, of a light-green color, another one-carat light-blue one from Royalston, Massachusetts, and perhaps the finest specimen ever found, at the Portland (Connecticut) quarries, fifteen carats in weight, and of such a rich, deep sea-blue color as almost to rival in splendor the matchless three-carat Brazilian blue-stone that is in the same case.

A fine blue crystal from Mourne Mountain, Ireland, is interesting for its locality and deep color. Stoneham, Maine, has contributed a two-carat white cut stone and a similar fragment; while Siberia is represented only by a common white stone of about six carats' weight.

Next comes a series of the emerald-yellow and yellowish-green varieties of spodumene (variety Hiddenite), embracing lithia emerald in the rough, and three cut stones of the same, weighing from a quarter to three-quarters of a carat, and varying in color from green to yellowish-green, from Stony Point, North Carolina; also a quarter-carat light-yellow and a one-carat golden-yellow spodumene of the variety resembling chrysoberyl, described by Pisani, of Paris, in "Comptes Rendus" for 1877, from Brazil. The white cut phenakite of three carats' weight, from Russia, is of rare occurrence, but has recently been found at two localities in Colorado.

The tourmalines include a dark-red gem (rubellite) of six carats' weight, and good color; two light-red ones of one half carat each, and a fine dark-blue one (indicolite) of three eighths carat; four long bottle-green (called Brazilian emeralds) of two carats each; a half-carat white achroite; two olive-green stones of two carats each; and two sections of green crystals that have red centers. This difference of color between the outer and inner crystals is peculiar to tourmalines, as many as three colors being found in one crystal. All these are from Brazil. The well-known domestic localities are represented by an oblong, table-cut, light-green stone from Paris, Oxford County, Maine, that once held a conspicuous place in the collection of Dr. Joseph Leidy, which, unfortunately, had to be scattered. From Auburn, Maine, a locality quite recently discovered, we have a one-carat blue indicolite, two lavender-colored stones of one carat each, a light emerald-green stone of three quarters of a carat, and as handsome as an emerald by artificial light, and also a suite of several dozen loose crystals of various colors. The neighboring two-carat yellow and three-carat yellowish-brown cut stones are from Ceylon. The fine two-inch grass-green crystal and one-inch bluish-green crystal are also part of the treasure brought home by Professor Dana from the Wilkes Expedition of 1838–'42.

A six-carat blue and two-carat sherry-colored topaz from Siberia are exceedingly brilliant, but the domestic reputation is well sustained by the cinnamon-tinted fifteen-carat cut stone from Pike's Peak, Colorado, which is not surpassed in beauty by the brilliant white four-carat (Minas Novas) from Minas-Geraes, in Brazil. A series of crystals that have been "heated," follows, varying in color from dark pink fading into white according to the degree of calorification.

Among the garnets are ten flat, brilliant cut stones, four carbuncles, and six rose-colored, from Bohemia; six Tyrolese red garnets, two essonites (usually sold as hyacinths by the jewelers), four carats and a quarter carat from Ceylon, and a series, cut and uncut, from New Mexico, which furnishes the finest garnets in the world in point of color. In addition to these we notice a two-carat demantoid (green garnet or Uralian emerald) from Bobrowska River, Syssersk, in the Urals, and a brownish-green one-carat stone from the same locality.

From New Mexico we have a fine yellowish-green peridot or olivine, called chrysolite by the mineralogist, but not by the jeweler, and known as "Job's Tears" locally (from their pitted, tear-like appearance), while the Orient is represented by a beautiful olive-green cut stone.

From the zircons or jargoons we may single out for remark a number of small cut stones, yellowish-brown, pink, bluish-green, and white, the latter color being often produced by heating. Stones of this kind were at one time used for incrusting watches, which were

then sold as diamond-incrusted. Next we observe a fine, rich, hyacinth-colored gem (the true hyacinth of the mineralogist), a long, two-carat green, a yellowish-green, and a brownish-green three-carat stone, all from Ceylon. The two carat axinite from Dauphiny is one of the rarest of gems. A six-carat yellowish-green epidote from the Knappenwand, the well-known locality in Tyrol, should be mentioned.

Here, too, is a one-fourth-carat idocrase from Ala, in Piedmont. This mineral, which received the name vesuvianite, because it is found among the formations in the lava at Vesuvius, is sold by the Neapolitan jewelers, and used to make the letters I and V in the manufacture of initial or sentimental pieces of jewelry. The same mineral is found at Sandford, Maine, and other localities here, but rarely in gem form.

Iolilite (dichroite, cordierite), or water-sapphire (*saphire-d'eau*), as it is also called, is here seen in the form of a flat-cut stone, of two carats' weight, from Ceylon, and a cube, one-fourth inch square, from Bodenmais, Bavaria. These are not comparable with one found at Haddam, Connecticut, that was worn as a charm by the late Dr. Torrey. This stone has dichroitic properties: if viewed in one direction it appears blue; if in another, pure white.

The five-carat titanite, or yellow sphene, is from the Tavetchthal, in the Tyrol. This gem shows the play of colors peculiar to the diamond. Specimens have also been found at Bridgewater Station, Pennsylvania. There are three long, yellowish-brown andalusites, of two, one, and three-fourths of a carat weight, at times so dichroitic that they have been offered in London as Alexandrites. These are from Brazil, where fine green ones are also obtained.

Next in order is a light-green diopside, from De Kalb, New York, a locality which has yielded twenty-carat gems, of rich oily-green color, equal to the one-carat cut stone from Ala, in Piedmont.

A small, long, one-carat cyanite, from Russia, is noteworthy, as is also the suite of opals, consisting of two noble cut stones, from Hungary, and a polished slab of the light matrix from the same place, beautifully mottled with opalescent spots; a set of over twenty gems, white, yellow, and brown, from Querétaro, Mexico; and two fair, noble opals from Honduras, together with a one-inch, lusterless cut stone; three pieces of blue opal, in the impure brown limonite, or ironstone matrix, from the Baricoo River, Queensland, Australia, termed opaline by the jewelers, and also a cut stone from the same locality.

Of turquoise, we have a bluish-green piece, one inch and a half long, cut into a flat cabochon stone, from Los Cerrillos, New Mexico, a fine suite of the mineral in the matrix, recently brought on by Major J. W. Powell, from New Mexico, and a set of twenty-four gems from Persia, showing all the characteristic gradations of color between blue and green; a curious half-inch cabochon cut stone, and a piece one inch long in the matrix, from Arabia, noticeable for the pleasing con-

trast of the bluish-green stone on the background of the chocolate-colored matrix.

Hematite is exhibited, cut in the form of balls and in a cut intaglio, and a cut, one-carat rutile, from Alexander County, North Carolina; these so closely resemble the black diamond in color and luster as to have been mistaken for it when first found.

A dark, almost black hypersthene, from Norway, shows a pleasing bronze-like reflection on the dome of the cabochon. One of the most instructive of the series is a quantity of gem-gravel from Ceylon, containing sapphires of various colors, chrysoberyl, zircon, quartz, and other stones.

A series of the American stone, Thompsonite, found as pebbles in the Lake Superior region, presents some fine cut stones, with the circles from one fourth to three fourths of an inch across. A few large, polished pieces measure over one inch across. Some small pebbles of Lintonite found with the Thompsonite are also polished.

The quartz array is very instructive: it begins with a two-and-a half-inch Japanese crystal ball, and an eagle seal three inches high, of Russian cutting; cut citrines, cairngorm, and the so-called smoky, Saxon, or Spanish topaz, eleven of the dark-purple amethysts from Siberia, often wrongly called Oriental amethysts, and a set of seven from Brazil, show all the changes from light pink to dark purple.

Perhaps the most unique gem of the collection is a piece of amethyst that was found at Webster, North Carolina, and deposited here by Dr. H. S. Lucas. The present form is just such as would be made by a lapidary in roughly shaping a stone, preliminary to cutting and polishing it. It now measures seven centimetres in length, six centimetres in width, four centimetres in thickness, and weighs 136·5 grammes. It was turtle-shaped when found, and this was said to have been the work of prehistoric man. This shape was unfortunately destroyed by chipping it to its present form. It is perfectly transparent, being slightly smoky and pale at one end, and it also has a smoky streak in the center. This coloring is peculiar to the amethyst, however. There are also a three-quarter-inch yellowish quartz cat's-eye from Ceylon, and a three-carat green one from Hoff, Bavaria, and a native Indian necklace from Ceylon, composed of numerous yellowish quartz cat's-eye beads of about three carats each.

We have, then, a beautiful series of the brown-quartz cat's-eyes, so-called crocidolite cat's-eyes (also called tiger-eyes), in fine slabs, balls, buttons, etc., which is really a combination of crocidolite fibers coated with quartz. This incasing renders it harder than unaltered crocidolite, which is to be seen here together with it. All these are from South Africa. Superb rutilated quartz (sagenite, *flèche d'amour*, Venus-hair stone, or Love's arrows), in the rough and in cut form, are from North Carolina. Rhode Island contributes black hornblende blades in quartz, and green actinolite in the same (the Thetis-hair

stone of Dr. Jackson). The actinolite, when in straight layers in the quartz, occasionally forms a quartz cat's-eye, if cut across the fibers.

The large pieces of black onyx, chrysoprase, carnelian, and sardonyx, the series of agates, of various colors, are cut into a variety of forms; the fine three-inch-square slab of "gold quartz," of the jewelers, is from Grass Valley, California.

Fine avanturine quartz, with spangles of mica in a rich reddish-brown quartz, from Russia, vases of which are often worth thousands of dollars; and a fine green avanturine, called imperial jade by the Chinese, and more esteemed by them than any of the true jades deserve attention. The series of fifteen small Indian mocha-stones is very attractive; the black, moss-like markings are relieved by the red spots in the gray body of the stone, thus presenting a surface beautifully diversified. A rich, brown, speckled jasper is worthy of notice. The two cut moldavites (Moravian bottle-glass), about one inch across, are of rare occurrence. They are transparent, dark-green obsidians, from Moravia, for which worthless green bottle-glass has sometimes been sold.

The two sun-stones from Norway—the largest one and a half inch long, the other a three-quarter-inch cut cabochon—are indeed fine, but a cut stone of the same material, over one inch long, from Delaware County, Pennsylvania, is nearly equal to them. Labradorites are fully represented, some polished pieces being over one foot across, and a number showing the beautiful chatoyant colors to perfection.

Amber, yellow, transparent, and containing flies and other insects, is present in the form of cut stones and beads.

A rich, dark-brown cut aragonite from California, and the beautiful green, copper-colored Smithsonite (a zinc-ore), from Laurium, Greece, demand special notice. One is a cut cabochon over one inch high, the other an ideal piece of the natural mineral. We observe also a fine polished malachite from Siberia, and a dish of the highly prized dark-blue fluorite from Derbyshire, England, where it is familiarly known as "blue John." Vases of this material have often been sold for over one thousand dollars. A slab of the Persian lapis-lazuli, and one of the white-veined variety from the Peruvian Andes, well represent this species. A jade pendant, three inches long and of good color, is one of the sort made in Germany to sell in New Zealand as genuine aboriginal workmanship. Also a flat vase made of a light-green Chinese jade, and one of the small bracelets of the same material, which are put on the arms of girls in early childhood, and allowed to remain there until the natural growth of the arm fixes them so tightly that they can not be removed over the hand. A rich yellow flower chiseled out of serpentine, about four inches by two, is very pretty, as is a curious, fanciful, dragon-like, talc ornament from Southern India. Red, white, and mottled agalmatolite (Chinese figure-stone), from China, is interesting.

One of the finest specimens of its kind in the United States is a magnificent six-by-four slab of lumachelle ("fire-marble") of fossil origin, in which the color of the original shells is so deepened and intensified that it rivals the finest fire-opal. This comes from the old, exhausted locality of Carinthia, Germany. Of alabaster, we have white, yellow, and cinnamon-gray slabs; of fossil coral, a fine slab from Iowa City. The oölite limestone from Bristol, England, is curious; the surface is highly polished, presenting a white field flecked with dark-red. Beads of gypsum satin spar and a three-inch egg of the same material are from Bideford, England.

The collection ends with an eight-by-three slab of catlinite (Indian pipe-stone), from Coteau du Prairie, Pipestone County, Minnesota. The head delineated on it was carved by a Washington sculptor, and came into the museum with the Abert collection, which was given to the museum.

To the energy of Professor F. W. Clarke is due the credit of forming this most interesting series of gems.

THE WHIPPING-POST.

By LEWIS HOCHHEIMER.

WHEN men, under the impetus of the indignation and horror that are occasioned by the commission of crimes that bear the stamp of deliberate cruelty or atrocity, undertake to apply what are popularly deemed adequately severe remedies, their action generally embodies results that, to the mind of those versed in matters of social or governmental science, are as mischievous in their tendency as the evils sought to be remedied. It not infrequently happens, in cases of crimes of deep atrocity, that citizens resolve to *avenge* the wrong immediately, by *lynching* the offender. The folly and wrong of this method of meting out punishment in a civilized community are now universally conceded by calm-thinking and intelligent men. Again, it will happen that this same spirit of impatience at the slow processes of law and of distrust in the ordinary legal methods of punishment for crime will find its expression in an equally wrong and illogical method, to wit, the adoption of *legislation* providing cruel methods of punishment for certain crimes, in the belief that the evil of their frequent perpetration may be remedied in that way. Upon reflection, it will be found that both methods have their origin in the same erroneous conception of the scope and object of *punishment for crime*.

Under the designation "cruel punishments," I include all such penalties for crimes as are designed to inflict direct physical suffering, accompanied by circumstances of ignominy. The whipping-post is

an example. The infliction of such penalties proceeds upon the theory of *retaliation*, and, for this reason, is improper and vicious. The legitimate province of all laws relating to penalties for crime is *punishment* simply. Anything that is inflicted beyond this, whether *against* law, as by mob violence, or by *legislation*, as in the case of retaliatory punishments, exceeds the legitimate scope of penalties for crime. There may be *scriptural precedent* to the contrary, but we must not adopt as a divine precedent, applicable to all nations, those rules which were laid down for a particular people, in a remote and barbarous age. Many things that are faithless, treacherous, unnatural and cruel, find a seeming sanction and precedent in the Mosaic law. Punishment, in its proper acceptation, means the protection of society, as represented by the State, against the inroads of the individual upon its welfare, or, as it is called in criminal-law phrase, "the peace of the State." It is only when the encroachments of the individual upon the rights of others amount to a *public wrong* that they are punishable criminally, and then it is only the wrong to society, and not the sin, that is cognizable by the tribunals.

Looking, then, at punishment in that light—viewing it as designed merely to conserve the public welfare, "the peace, government, and dignity of the State," as it is technically expressed in every formal indictment for crime in Maryland—by what consideration should we be guided in determining the true policy to be pursued in the application of punishments? Surely, not the narrow one of (at all hazards) *suppressing* the particular crime. Crime can not be stamped out by any heroic methods of treatment. Sin and crime are inevitable conditions incident to our present state of social advancement, just as disease is a factor of our physical being. He would be deemed an unskillful physician who directed all his efforts toward the driving away of a particular malady without regard to the effect of his course of treatment upon the general system of the patient. A like want of skill in statesmanship is exhibited when the legislator proposes such a remedy as that enacted in Maryland for wife-beating, to wit, the whipping-post, without weighing the effect of the introduction of that sort of remedy upon the constitution of the body politic.

The arguments advanced in support of this legislation are as plausible and as apt to impress the popular mind as they are fallacious and illogical. The crime of the brutal wife-beater affords an excellent topic for declamation and invective, and people of generous, high impulse are very prone to yield their cooler judgment in such matters to specious rhetoric. The purpose of this paper is to discuss the question from a logical stand-point, free from all declamation or sentimentalism, in which the discussions of such questions too frequently abound.

Now, firstly, let it be borne in mind that, in the discussion of a question of punishment for crime, we deal with public interests. Mere satisfaction to the individual upon whom the crime is perpetrated is

not to be considered, nor is the matter of the welfare of the offender to control our action in dealing with crime. Both interests must yield to that of the State, which is the injured party. The errors most frequently committed in forming a judgment as to the punishment due for any crime arise, on the one hand, from an excess of hostile feeling toward the offender, which obscures our view of the real end to be accomplished by his punishment, and, on the other hand, the opposite bent of letting sympathy and excess of kindly feeling shut out from our view the demands of public justice.

In traveling through the dark mazes of human frailty and crime, it would be difficult to find an object more seemingly devoid of every nobler human instinct than the cruel wife-beater, for whose offense a recent Maryland statute has revived the lash and whipping-post; unless, indeed, it be that loathsome specimen from the list of criminals, in whom humanity seems to have sunk to its lowest ebb, the cruel child-beater. But, let us proceed to answer the real question which the punishment of the wife-beater raises for solution. Does *society*, whose laws have been broken and must be vindicated, upon the whole, gain or does it lose by the method of punishment under discussion? Granted that the whipping-post will stamp out the crime of wife-beating in our midst, does the gain justify the price?

To illustrate my meaning clearly, I lay down the following proposition, which will not be gainsaid by any one versed in matters of social science. If, in the case of any given offense, no punishment to be meted out to the offender could be devised that would be *effective* in deterring others from committing the like offense, then the State could not rightfully punish at all, however heinous the offense. Why? Because, in the language of an eminent and conservative writer upon this subject, "the end of punishment is not by way of atonement or expiation of the crime committed, for that must be left to the just determination of a Supreme Being, but as a precaution against future offenses." Unless the punishment can be made effective for the conservation of the peace of the State, we are not justified in inflicting it. From this the further proposition follows, that the State may inflict no further or greater punishment than is absolutely necessary to attain that end, the protection of society. Do these interests require and are they advanced by the infliction of lashes upon wife-beaters?

It may safely be stated that a husband, before he beats his wife to the brutal extent that is contemplated by the statute authorizing lashes, has already sufficiently shown his evil character to warn his wife that he is no fit husband for her to dwell with and enable her to procure the separation to which the law entitles her. If this were done, all occasion for any such crime would be avoided, and the wife would be protected, and society protected. But, must a wife, simply because her husband is a brute, seek a divorce, and thus lose home and husband, and, moreover, deprive her children of their home and

their father's support? Should the brute not rather be flogged and made to bear the punishment which is *his* due, instead of punishing his *wife* and *children* by a separation? These questions, which I have heard asked frequently, I shall endeavor to answer. A separation is a hard remedy. Through no fault on their part, the man's wife and children suffer bitterly. If the whipping-post could obviate all this, that would be an argument strongly in its favor; but what are the results of lashing the man? I will detail them. 1. You deprive him of his *citizenship* ban, and banish him. He can never return to the community in which he lived and face his former acquaintances. 2. All his usefulness as a member of society is destroyed. All the good that was ever in him is driven out. With every lash you sear his soul and instill hatred and bitterness that can never be effaced. He, thenceforth, becomes a hapless wanderer and an outcast, with no ties or aspirations in common with his fellow-men. 3. His wife is *divorced*, practically, without the benefit of a regular divorce. Why so? Because the man, after being lashed, will never again return to her. You may assuredly assume this. But that is not all. 4. His children, most innocently and undeservedly of all, will suffer keenly. Not only are they deprived of their father, who will leave home, and friends, and usefulness behind, but they will be spoken of and treated slightingly by their youthful companions as the children of the man who has been flogged, and the stain will cling to them until the grave has closed over their remains. The very things to be deprecated and avoided are thus brought about by the whipping-post. According to a natural though not just impulse of our human nature, the very wife whose husband has been flogged on her account will meet with a degree of scorn, however undeserved. The State has, in no case, the right thus practically to *destroy* a citizen.

Apart from all these considerations, the demoralizing effect and brutalizing tendency of a public lashing should alone operate to condemn such legislation. While wife-beating may be suppressed, such exhibitions as were witnessed in Baltimore recently sow seeds that will crop out in other directions and produce a harvest of crime. This is a natural law, well understood by students of penal science. No exhibition can have a worse tendency than the public treatment of a human being in a manner that ignores his claim to consideration as such. The recent exhibitions, as related in the local newspapers, of a sheriff walking through the streets of Baltimore, "jauntily dressed," in procession with his "staff," and reported as feeling in "elegant trim" for his job, windows being raised all along the route, women and children rushing to pavements and casements, were a sad commentary upon our "improved" laws. The fruits of those exhibitions will outweigh, in their evil, all the possible "reformation" hoped for from such legislation.

Another consideration is the following: No man, by *any* act of his, can forfeit or lose his human nature. We are all created in one

image. The strictest or most intolerant (put it as you choose) creeds give a man until after death without repentance before consigning him to perdition everlasting. Here, however, the State shuts out a man from repentance, treats him as a brute who has *forfeited* all right to consideration as a man. For, when we inflict *ignominy*, we do all this. In doing this, in disgracing a being created in the image of God, we simply insult the great Being who has implanted his image and spirit in all of us. However far we may stray from grace, we can not, by our acts, divest ourselves of our human nature or forfeit our claim to consideration as human beings.

The advocates of cruel punishments ask, How can you cope with brutality and brutal men unless you treat such men after their own fashion? You must meet brutality with brutality, is their plea; you must adopt strong remedies for evils that will not yield to mild measures. It might be answered that such punishments do not fulfill their end, and the history of all times and the testimony of the most enlightened students of such questions in all countries might be appealed to in confirmation. When, under English law, two hundred different actions, "many of them," according to a great writer on criminal jurisprudence, "not deserving the name of offenses," were punishable by death, and offenders were whipped, scourged, pilloried, hanged, quartered and sometimes roasted alive, crime was not less frequent, nor were the laws violated with less ado than to-day. The very circumstance that whipping and similar punishments have had their day of trial and were abolished by a generation that witnessed the workings of the system in all its full-blown beauty, demonstrates its unsatisfactory character to the minds of those best acquainted with it. But I go further. Crime is inherent in our defective civilization, and you can't hurry up the march of civilization in any such patent way as lashing men. Criminal law is not a panacea to soften the human heart. Civilization has reached a certain height or state of development, and sin and crime are concomitants of that state. While crime must be punished, it can not be wiped out. Human nature is so constituted that men revolt at the deliberate infliction of pain upon a fellow-being, more so, indeed, than at any violence or brutality committed by the offender in the heat of passion. Any punishment that shocks the moral sense of a community, as all cruel punishments are calculated to do, falls short of its mark and fails signally to produce the general satisfaction always arising from the administration of wise punishments. Wife-beating is the outcome of a state of society that produces numerous evils of equal degree of which the general public, not acquainted with reformatory work among criminals, are entirely ignorant. Brutal as the offense is, brutality will not be suppressed, civilization will not be advanced one shade nor society benefited or protected by resort to retaliatory punishments. That kind of proceeding always defeats its own object.

SKETCH OF HUYGENS.

NO name in the history of science is associated with more material advance, or with advances in more various directions, than that of Huygens. To him we owe important improvements in the telescope, which in his time was a very crude instrument; the discovery of the first satellite of Saturn and of the nature of his ring; the accepted theory of the character of the surface of the moon; the undulatory theory of light, which had to wait till our day to be verified or even accepted; the theory of the pendulum and of the properties of the cycloidal curve; continuous fractions; with Newton, the determination of the shape of the earth; the knowledge of the properties of double refraction and polarization; many other discoveries of practical use or theoretical value; and a few ingenious speculations which have been used to lend attraction to some works of popular science.

CHRISTIAN HUYGENS VAN ZUYLICHEM was born at the Hague, April 14, 1629, and died June 8, 1695. He was the second son of Constantine Huygens, secretary and counselor of three successive Princes of Orange, who was also a distinguished Dutch poet and writer of Latin verses. His grandfather, too, was a secretary to the great William the Silent; and his elder brother Constantine, serving in the corresponding capacity, accompanied Prince William Henry to England, where he went, in 1688, to become King William III.

His earlier instruction was attended to by his father, who, remarking the signs of promise in him, taught him music, arithmetic, and geometry, and, when thirteen years old, mechanics. At fifteen, he was given an instructor in mathematics; at sixteen, he was sent to Leyden to study law under Vinnius; and he attended the University at Breda from 1646 to 1648. In these cities he enjoyed the instructions of the skilled geometricians, François Schooten and Jean Pell, and his first essays in that branch of mathematics were so fortunate as to attract the attention of Descartes, who wrote concerning it: "A little while ago Professor Schooten sent me a tract by the second son of M. de Zuylichem, touching a mathematical invention which he had sought out; yet he did not find in it what he was looking for (and this was not strange, for he was seeking what no one has ever yet found); but he went at it so straightway that I am sure he will become excellent in that science, in which I hardly ever see any one who knows anything." Huygens also had unbounded admiration for the great philosopher, but never enjoyed the privilege of meeting him.

The prediction of Descartes was very speedily fulfilled, for, within a few years after his graduation, having taken a short journey with Henry, Count of Nassau, Huygens began the series of labors and publications that have made his name immortal, with his theorems, in

1651, on the quadrature of the hyperbola, ellipse, and circle, following it with a criticism of Père Gregory de Saint Vincent's treatise on the same subject, and, three years afterward, with his discoveries on the magnitude of the circle (*de circuli magnitudine inventa nova*).

In 1655 he went to France, and received a degree in law from the Protestant Academy at Angers. Returning to Holland, he engaged with his brother in the manufacture of large lenses. With one of these, an objective of twelve feet focal distance, he discovered the first satellite of Saturn (the sixth in the order of distance), and announced the fact, after the manner of his time, in an anagram. It is said that, in the excitement attending his achievement, he engraved his anagram upon the glass itself by the aid of which the discovery was made. He afterward made glasses with one hundred, one hundred and seventy, and two hundred and ten feet of focal distance, which could not be inclosed in a telescopic tube on account of the swagging, to which so long an instrument would be subject, but for which he contrived a kind of framework support, while the observer stood at the focal point, eye-glass in hand. The necessity of using such cumbrous contrivances has happily been dispensed with by the introduction of reflecting telescopes.

In 1656, Huygens published, in Dutch, a memoir on the calculation of probabilities, for which Pascal and Fermat had prepared the way, and which was translated into Latin by his preceptor, Schooten, to be inserted as an appendix to his "Mathematical Exercises," in illustration of the usefulness of algebra. In the same year he invented the escapement of watches and clocks. Galileo had already recognized the synchronism of the motion of pendulums, and experimenters had begun to avail themselves of it in timing their observations; but they knew of no better way of using the pendulums than to employ a man to keep them in motion and count their vibrations. Huygens connected them with clock-work, very much as we now have them, and made the whole operation automatic.

In 1659, having constructed an objective of twenty-two feet focal distance, Huygens turned his attention to Saturn's ring, which Galileo had perceived but dimly, discovered its true character, calculated its elements, and predicted its temporary disappearancee in 1671; a prediction which his fellow-astronomers saw fulfilled twelve years after it was made, with great admiration for his genius. In his work, giving an account of these observations, "Systema Saturninum," he also described the nebula in Orion, and the bands of Jupiter and Mars, announced that the fixed stars had no perceptible diameter, and made known his device for measuring the apparent diameters of the planets, an incipient micrometer. He discovered but one of the satellites of Saturn, and did not seem to care to look for any other; for his enterprise in this direction was bound by the opinion he entertained that there was a relation between the number of planets and of satellites;

and there were already six planets—Mercury, Venus, Earth, Mars, Jupiter, and Saturn; and six satellites—one for the Earth, four for Jupiter, and one for Saturn. This fancy did not, however, prevent his afterward accepting Cassini's discovery of four other satellites of Saturn, and speculating from it upon the possibility of there being still others, either between some of those already discovered, or beyond the orbits of all.

Huygens, having now attained a very high and extensive reputation, visited France and England in 1660 and 1661. He explained his method of grinding lenses to the scientific men of England, and, finding them occupied with the recently introduced air-pump, took back with him the idea of that instrument when he returned to Holland, after two years, to develop it and improve upon it. Remarking in his experiments the close adherence of two plates of polished metal *in vacuo*, he conceived that it was due to the same cause as that which, operating at still closer quarters, produces cohesion. At about the same period he developed a rule for estimating the height of a place by the local pressure, and reciprocally, for calculating the pressure at a given place from its elevation above the sea. He was made a member of the Royal Society of London, and communicated to it the solution of the law of impact of bodies, at which Descartes had made an unsuccessful attempt. His own solution involved the laws of motion, and of action and reaction, in the main as they are now understood, and contained the germ of the law of the conservation of forces.

In 1665 he accepted an invitation from Colbert to go to Paris and reside in the Bibliothèque Royale. There he wrote his treatises on dioptrics and the law of percussion, in a literary style which won from Newton the remark that it more nearly approached the style of the ancients than that of any other modern author. Subsequently he composed the greatest of his works, the "Horologium Oscillatorium," which was published in 1673, and has been pronounced, with the exception of Newton's "Principia," the finest work on the exact sciences of the seventeenth century. In the dedication of this work to King Louis XIV, he revealed the dominant characteristic of his mind, making it the great object of all his researches to find out useful things, to promote the knowledge of nature, and add to the comforts of living. "I shall not waste any time, great king," he said, "in demonstrating to you the usefulness of these things, for my automatons (clocks) placed in your apartments will impress you every day with the regularity of their indications and the consequences they promise you in the progress of astronomy and navigation." The first chapter of this work was devoted to the description of pendulum-clocks; the second chapter embodied a study of the motion of a grave body moving along a given curve, in which was established the tautochronism of motion in a cycloid. In the third chapter, concerning the evolution and dimension of linear curves, was introduced the idea from which

the author deduced the theory of evolutes. In the fourth chapter he determined the center of oscillation of a pendulum, and consequently the length of the simple isochronous pendulum; and in the fifth chapter was estimated the measure of the centrifugal force in circular motion.

We next find Huygens devising the application of the spiral spring to clock-movements, and making pocket watches and sea chronometers possible, and then disputing for the priority of the invention with the Abbé Hautefeuille, "one of those schemers who begin everything and finish nothing."

Huygens turned his attention to the study of the properties of light and weight and of the magnet, and communicated his results to the French Academy and the Royal Society. His theory of light was the one which is now generally accepted after having slept for a hundred and fifty years. Double refraction attracted his attention, and he explained that it was occasioned by an ellipsoidal form given to the light-waves, while in ordinary refraction the waves were spherical. To account for gravity he accepted the Cartesian vortices, and supposed that those bodies which were too unwieldy to keep up with the motion of the outside circles were forced to fall back into the inner circles, where the motion was slower, thus approaching the center. Considering the phenomena of terrestrial gravity exhibited in the variations of the oscillations of the pendulum, he concluded that the earth was a spheroid and not a sphere. He accounted for magnetism in a paper which has never been published, by a theory that has not endured. He left France in 1681, some say on account of the Edict of Nantes, others because his health was bad and he needed a change. At home in Holland he constructed an automatic planetarium to represent the motions of the solar system, and in doing it discovered the theory of continuous fractions.

In the mean time a revolution was taking place in the world of mathematics, through the discovery of the differential calculus by Leibnitz, a philosopher who has said of his intercourse with Huygens, some ten years previous to this time (1672 and 1673), that it opened a new world to him and made him feel like another man. The use of the new method would have greatly facilitated the calculations Huygens was making, but he had become skilled in the old ways, imperfect as they were, and not always of universal application, and, being too old to change his method readily, continued to employ them. But, after a discussion of the merits of the new system in correspondence with Leibnitz, he came to a full appreciation of its value, which he expressed freely by saying that he observed "with surprise and admiration the extent and fruitfulness of that art; on whatever side he turned, he discovered new uses for it; and conceived it destined to infinite progress and speculation."

The "Cosmotheoros," or "Observer of the World," which was not

published till after the death of Huygens, was chiefly a treatise on the habitability of other worlds than ours, and was marked by curious and ingenious speculations, of a character from which his other works were almost entirely free. In this work, after expressing his belief in the existence upon the planets of living bodies in no way inferior to those on the earth, he added: "What obliges me to believe also that there is a rational animal in the planets is that, if there is not, the earth would have too great advantages (while it is one of the smallest of the planets) and would be too much elevated in dignity (while it is neither the nearest to the sun nor the most distant from it) over the other planets, if it had an animal so much superior to all that they have. . . . Finally, is it reasonable to suppose that the heavenly bodies among which our earth occupies so modest a rank have been created only in order that we other little men may enjoy their light and contemplate their situation and motion?" He also gave some vivid pictures of the scenery of the heavens as observed from the different planets, paraphrases of which had wide circulation in an English work of popular astronomy of the last generation. In observing the moon he made a study of its mountains and plains, and, remarking that the latter were too rough to be lakes or oceans, concluded, what is now generally believed, that the moon has no bodies of water; also that it has no atmosphere—none at least that rises above the valleys.

At the beginning of the year 1695, Huygens lost his faculties—an affliction he had suffered once before while residing in Paris, but from which he had recovered after removal to his native land. This time the affliction was permanent, except for a few lucid intervals which he employed in making testamentary dispositions of his property, and in consigning the care of his manuscripts to his friends Bürcher de Volder and Bernard Fullen.

Like his illustrious contemporaries Descartes, Leibnitz, and Newton, Huygens was never married. He is described as having had a good figure, and been possessed of a noble and elevated character. He was affable and frank in his disposition, and gave a warm welcome to inquiring young men, whom he was always ready to direct in the way of discovery. It was thus that Leibnitz came to him and received the inspiration of which we have quoted the acknowledgment. Though qualified by birth and fortune to shine in society, and constrained to figure there for a part of his life, he preferred retreat, and passed all of his time that he could in the country, immersed in his studies and experiments.

EDITOR'S TABLE.

THE GLADSTONE-HUXLEY CONTROVERSY.

WE yield the considerable space in our present number which is necessary to complete the discussion between Mr. Gladstone and Professor Huxley as the chief parties, on the scientific status of the Pentateuch, in its claims to embody and anticipate in an extraordinary manner the great results of modern science. Mr. Gladstone argues that the statements made thousands of years ago in the book of Genesis in regard to the manner and order in which this earth and its living tribes were produced conform so remarkably to the grand results of modern scientific research as to form a powerful argument in favor of the divine inspiration of the old Jewish chronicles. Professor Huxley takes issue with this conclusion, maintaining that there is nothing like the wonderful agreement alleged, as sufficient to constitute a "plea for a revelation from God," but that, on the other hand, the disagreements between the two records are so great as to be irreconcilable.

This is an old and hard-contested controversy. At first, and for a long period, the Bible, as a paramount and infallible authority, became a powerful instrument in the hands of bigotry and intolerance for the repression of science. For a long time the facts of observation and the proofs of experiment were of but little weight before the authority of Scripture texts. But theologians at length discovered that this was untenable and indeed dangerous ground; as, to plant the Bible squarely in the pathway of advancing science, would be certain to destroy its influence. The lead at last had to be given to the truths of observation and experience, against which it was of no use any longer to quote Scripture. But then came the task of reconciling biblical statements with scientific truths, and for a long period an immense amount of ingenuity and learning was expended to show that the Bible is in perfect harmony with science, and that all its most striking and important results are to be found there, expressed or implied. But neither could this ground be maintained; and after generations of heated contest the great controversy gradually settled itself by the general acceptance of the principle that the Bible was not given to teach science, and is therefore not to be judged by scientific standards. Hence, the present discussion seems now rather anomalous—the revival of an antiquated subject—which derives its chief interest from the eminent character of the parties engaged in it. Mr. Gladstone is, however, an old man, and, though still in great force, he represents ideas and phases of thought upon this question that were far more absorbing and ascendant half a century ago than they are now.

EDUCATION IN POLITICS.

A CORRESPONDENT of the "New York Times" sums up the functions of the Superintendent of Public Instruction of the State of New York as follows:

> The duties imposed upon the office require a man of education and of positive parts to satisfactorily discharge them. The act of 1854, which created the office, defines its duties at considerable length. It gives this officer general superintendence of the public schools of the State. It requires him to visit them, to inquire into their management, and advise and direct in regard to their course of instruction and discipline. He apportions and distributes the public moneys appropriated by the State for the support of schools, examines the supplementary appointments made to all the districts by the School Commissioners, and sees to it that each district is

set apart its proportionate share, and that the same is expended by the trustees and paid by the supervisors of the towns according to law. He gives advice and direction to school officers, teachers, and inhabitants upon all questions arising under the school laws. He establishes rules and regulations concerning appeals, hears and decides all appeals involving school controversies, and his decision is final. He is charged with the general control and management of teachers' institutes in the various counties, is authorized to employ instructors for the institutes and to pay them, and to certify the accounts for expenses incurred by the School Commissioners in conducting the same. He is required to visit the institutes, and advise and direct concerning their proper management.

He makes appointments of State pupils to the institutions for the instruction of the deaf, dumb, and blind, and generally supervises the management of these institutions. He established rules and regulations concerning district-school libraries. He apportions among the counties the number of pupils in the State Normal School to which each is entitled. He has charge of the Indian Schools, employs local agents to superintend them, and gives directions in regard to the erection and repairs of their school-houses. He is an *ex-officio* member of the Board of Regents and chairman of the Committee on Teachers' Classes in the Academies. He is also an *ex-officio* member of the Board of Trustees of Cornell University, of Syracuse University, of the Idiot Asylum, and of the People's College, and chairman of the Executive Committee of the Albany State Normal School. He is also charged with the general supervision of the State Normal Schools at Brockport, Buffalo, Cortland, Fredonia, Geneseo, Oswego, and Potsdam. He receives and compiles the abstracts of the reports from all the school districts in the State. The salary of the Superintendent is five thousand dollars, and he has a deputy, and is allowed to employ a force of clerks, whose aggregate salaries shall not exceed nine thousand dollars a year.

This is a very extensive list of duties and responsibilities to be intrusted to any one functionary by the self-governing people of a great State, especially on a subject so extensive and important, and we may add so domestic and social, as that of education. One would think that an intelligent and independent community would be somewhat scrupulous about parting with the control of its children in the matter of instruction, and would prefer to attend to that matter themselves, rather than to be much superintended by any distant office-holder who happens to be thrust into the position where he can regulate the schools of the State. But the Superintendent of Public Instruction is the head engineer of that vast political machine which has come to supersede all private agency in the formation of the minds and characters of the young so far as it is possible for schools to do it. We say "political machine," because the great work of carrying on primary education in this country is being steadily and rapidly swallowed up in the gulf of politics. Indeed, the fundamental reasons given for the existence of our common-school system, and avowedly the sole reasons for which it can be maintained, are political. It is freely admitted that the State has no other warrant for taking in hand the instruction of the young than to shape them as citizens in accordance with the political system we have adopted. As a consequence, the business of administering education is becoming a prominent part of politics, and appointments in all the best-paid positions are being more and more determined by the common influences of political manipulation and intrigue. The influence of this state of things upon teachers who are now all government office-holders is a chapter of the subject that can not be here dealt with, but is full of interest. Our object is now simply to call attention to a conspicuous illustration of the control of partisan politics over our whole system of State instruction.

No intelligent person will deny that the general subject of education is one of great complexity and great difficulty, and that to control it wisely and improve its practical methods is a task requiring much ability, long and profound devotion to its fundamental questions, and a wide and varied experience in educational work. But very few men

can be found combining the rare qualifications needed in a State Superintendent of Education; at the very best these qualifications can only be secured in a partial degree, but this makes it all the more necessary that no effort shall be spared to secure the best talent available for so responsible a trust. It is needless to say that this desirable object is impossible under the political *régime* into which our popular education has now passed. The superintendency of schools of the State of New York has become a foot-ball of partisan faction among the politicians of the New York Legislature. The former Superintendent resigned some weeks ago, to take a more profitable office; and the temporary incumbent of the place will vacate the office in April, to be succeeded by whomsoever the Legislature appoints. A crowd of applicants of all sorts are after the place, lobbying and intriguing in Albany by all the means that are necessary to secure "success" in the scramble for a desirable position. That a competent man will be appointed under these circumstances is virtually impossible, for no thoroughly competent and self-respecting man would enter the lists of competition under these circumstances. The appointee will win because he or his friends can beat all competition in the questionable arts by which politicians are influenced, and the result will be legitimate—a natural outcome of the system by which the instruction of the young has been brought under political and therefore, of course, under partisan control.

Another exemplification of the influence of politics upon education is seen in the "Blair Bill," which proposes that Congress shall make a gift of seventy-seven million dollars, to be divided among the States of the Union to help them maintain their schools. The success of the bill, as we write, is said to be uncertain; but, whether it pass or not, it has had so extensive a backing as to well illustrate the sort of influence which politicians would bring to bear upon education. The tendency to make education a charity, and to bring school-houses into the same category with poor-houses, is sufficiently strong; but this measure, by an audacious stretch of constitutional power, would give the stamp of nationality to the charity policy. The scheme proceeds upon the peculiarly American assumption that anything can be done with money, and that the Central Government has only to scatter millions enough and all the people will be educated. But the assumption is false: there are things which no amount of money can do, while the evils of its lavish distribution are not only palpable and certain, but may result in the absolute defeat of the object intended. That the distribution of this seventy-seven million largess among the States would be profoundly injurious to the interests of popular education does not admit of a doubt; and the American Congress would have to make the experiment but once more to paralyze and destroy the existing common-school system of the country. For, by the results of all experience and the very necessity of things, those who expect to be helped will depend upon help, and put forth less effort to help themselves. Whatever lessens the interest taken by parents and citizens in the working and character of the schools, whatever tends to diminish their direct responsibility in regard to them, and to weaken the sense of obligation to make sacrifices for the instruction of the young, strikes a demoralizing and deadly blow at the springs and incentives of all educational improvement. Our people have yet to learn that one of the highest benefits of a popular educational system is in training parents and citizens to the efficient discharge of their social duties, and a national policy which undermines these obligations can not be too strongly reprobated.

Our readers are reminded that one of the most important scientific papers that have appeared in "The Popular Science Monthly" since its establishment is that by Herbert Spencer, in the present number, on "The Factors of Organic Evolution." It is a popular paper, but it will demand close attention to appreciate its significance and its force. The biological questions discussed are fundamental in organic evolution, or the theory of descent with variations, and Mr. Spencer brings into clearness aspects of the subject upon which there has hitherto been much confusion of thought. His root question is as to the import and value of the principle of natural selection contributed by Mr. Darwin, and the decision of which must fix Mr. Darwin's permanent place in relation to the doctrine of evolution. The need of a thorough investigation here is shown, on the one hand, by the confessed unsettledness in regard to the limits of the doctrine of natural selection, and how far it is capable of accounting for evolution phenomena—an uncertainty shared prominently by Mr. Darwin himself; and, on the other hand, by the exaggerated and extravagant claims that have been made for this principle as being all there is of evolution, and that Mr. Darwin is, of course, its founder. No man was so capable of dealing with this subject as Herbert Spencer, and it will be a matter of general congratulation that he has seen fit to take it up in the interests of science and of justice. But, quite aside from all personal bearings of the discussion, it will be found of the highest interest as a study in the progress of modern biology.

Mrs. Rickoff describes in another place in this number an exhibition of hand-work made out of school by children of from five and six to fourteen years, and draws various suggestive conclusions from the experience. Among these is the following remark: "One of the noticeable features of the exhibition was an apparent decline in originality of invention and spontaneity of thought after the first year or two at school." The inference, of course, is that the school exerted an unfavorable influence upon the manual practice. This could not well be otherwise, as the ideal of the schools is mental cultivation by books, and not by the exercise of the active powers; and, as the schools are machines run by verbal methods and backed by old bookish superstitions, the child brought under their influence will very naturally and very quickly lose any interest it may have previously acquired in manual efforts. The two systems are antagonistic, and we do not believe it is possible to graft any thorough or valuable plan of technical study on our public schools as at present organized. The technical system must be independently developed, and will force its way through or over the narrow, unpractical system that now has the field.

LITERARY NOTICES.

An Introduction to the Study of Chemistry. By Ira Remsen, Professor of Chemistry in the Johns Hopkins University. American Science Series. New York: Henry Holt & Co. Pp. 387. Price, $1.40.

This is one of the cases in which the bare announcement of the author's name goes far to establish the character of his performance. Professor Remsen could make no other than an excellent book on the subject of chemistry. He is a master of the subject, thoroughly familiar with its latest developments, a clear thinker, and a lucid writer, and he has besides had much practical experience as a teacher of the science.

The method of Professor Remsen's work is thus distinctly presented by the author. He begins his preface by remarking: "In preparing this book I have endeavored to keep in mind the fact that it is intended for those who are beginning the study of chem-

istry. Instead of presenting a large number of facts, and thus overburdening the student's mind, I have presented a smaller number than is usual in elementary courses in chemistry; but I have been careful to select for treatment such substances and such phenomena as seemed to me best suited to give an insight into the nature of chemical action. Usually the mind is not allowed to dwell for any length of time upon any one thing, and thus to become really acquainted with it, but is hurried on and is soon bewildered in the effort to comprehend what is presented. I can not but believe that it is much better to dwell longer on a few subjects, provided these subjects are properly selected.

"The charge is frequently made that our elementary text-books on chemistry are not *scientific*, that is to say, that not enough stress is laid upon the relations which exist between the phenomena considered — the treatment is not systematic. The student is taught a little about oxygen, a little about hydrogen, a little about nitrogen, etc.; and then a little about potassium, a little about calcium, etc., and he is left simply to wonder whether there is any connection between the numerous facts offered for study. It must be acknowledged that there are serious difficulties in the way of a purely scientific treatment of chemistry, but I think that it is quite possible to treat the subject more scientifically than is customary, and thus to make it easier of comprehension to the student. I have made an effort in this direction in the book here offered to the public."

Professor Remsen's remark about the difficulty in the way of a purely scientific treatment of chemistry here applies, as we suppose, to the difficulty of presenting it to beginners in the study, and is, of course, true; but we have considerable doubt whether the difficulty is to be met by any attempt to make the work of the beginner more scientific. From the quality of his book we must infer that Professor Remsen's "beginner" is a pupil advanced to considerable maturity of mind, sufficient to deal with conceptions of some complexity and comprehensiveness. It is assumed that he enters the laboratory, goes to work himself, and has such strength of thought that a few examples would be sufficient to familiarize him with the established interpretations and principles of the science. But the real "difficulty" in the case, we think, is, that a stage of mental growth has been jumped when more elementary conceptions of the subject could have been assimilated, and some preparation afforded for that scientific treatment upon which the professor proposes to enter. The child is, in reality, already familiar with many chemical phenomena, as facts of observation and experience, although he does not know that they are chemistry. The more rational method seems to us to begin considerally further back, and occupy the pupil at first with a range of simpler observations and experiments that shall acquaint him to a certain degree with the properties of substances and their simpler reactions, without attempting to grasp principles that can be better handled at a later stage. This would imply, of course, a grading of the subject, and an introduction to it as a part of primary education.

CLASS-INTERESTS: Their Relations to Each Other and to Government. A Study of Wrongs and Remedies to ascertain what the People should do for Themselves. By the author of "Conflict in Nature and Life" and "Reforms: their Difficulties and Possibilities." New York: D. Appleton & Co. Pp. 172. Price, $1.

HOWEVER we may regard the conclusions of the anonymous author of the present book, one thing is to be said in his favor—his views have only been reached by deliberate and comprehensive study. His volume is, at any rate, not to be classed with those products of hasty speculation on social subjects which are now so abundant. He began well at the beginning of philosophical inquiry, by writing an original volume on those necessary conflicts and antagonisms in nature and life which put limits to what can be accomplished in the various spheres of action in which men are engaged. It was a most wholesome and needed investigation, and that it excited so little attention and interest is painful evidence of that shallowness of thought and foolish extravagance of expectation with which political and social subjects are treated in Legislatures and by the press. The author's book on "Reforms: their Difficulties and Possi-

bilities," was an extension and application of the principles of the first treatise to immediate practical questions and measures which are occupying the general attention of the public. That discussion led to the present book on "Class-Interests," which, indeed, was originally intended to be published as a part of the volume on "Reforms," as a final application of his systematic views.

Nevertheless, the author's original studies in the antagonisms of things, and the limits to accomplishment which these antagonisms imply, seem to have been wholly insufficient to neutralize the bias of temperament or the power of preconceived convictions. He avows that the results of his studies bring him into "accord with wide-spread movements of thought and action in this country and in Europe"; and of these he refers, first and in particular, to "the amplification of government functions"—that is, he joins the swelling crowd of those who are looking for salvation from social evils to the politicians. For, say what we will, the fact remains that what we have actually to deal with as government is simply the men who have possession of political power, and, under our representative system, they are the selected and successful demagogues of the community. Our legislators, as a mass, who constitute the working power of government, are neither the wise men nor the good men of society, but men who are incompetent for their task—men without knowledge of the subjects upon which they are required to act, sordid and ambitious self-seekers, in short, office-holders and politicians who have beat all rivals. The "amplification of government functions" means, therefore, simply committing more and more the great interests of society to incompetent and untrustworthy hands. Our author condemns *laissez faire*, and makes the serious mistake, usual with the party of interference, of affirming that it is a "do-nothing" policy; whereas that is the only school we now have which aims to hold government to its supreme work of administering justice in society. But that great object is now so overlaid with added "functions" as to be buried out of sight and forgotten, so that those who demand that, first of all, government shall enforce it among citizens, are charged with being in favor of "doing nothing."

The present volume is profoundly sympathetic with the needs of the masses of the people, and it closes with a very valuable essay on moral education in our primary schools, which ought to be extensively read.

PROBLEMS IN PHILOSOPHY. By JOHN BASCOM, author of "Science of Mind": "Growth and Grades of Intelligence." New York: G. P. Putnam's Sons. Pp. 222. Price, $1.50.

THE more obscure and refractory problems in philosophy are here dealt with in a series of essays, each of quite moderate length. To the presumption, nowadays so strong, that such collections of articles are apt to originate in the idea of "gathering up everything, that nothing be lost," the author replies that in this case the work is essentially new, as but one essay, that on "Liberty," has appeared elsewhere, while that has been somewhat modified: The discussions have been kept within marked limits of brevity, the writer assures us, with the view of securing an explicit statement of a few fundamental principles, and to avoid the evils of excessive elaboration which are so incident to systematic treatises on philosophy.

Dr. Bascom has here reviewed a considerable number of the most knotty questions that have been held as at the foundation of philosophy, and that have for many ages exercised the ingenuity of speculative inquirers. Among the problems considered will be found "The Relativity of Knowledge," "Spontaneity and Causation," "Freedom of Will," "Consciousness and Space," "Universality of Law," "Being," and "Final Causes." The author seems to have but little sympathy with those who hold that the human mind is shut out from any final solution of these problems. He belongs to the intuitionalist school of metaphysics, which resists the efforts of the empirical or scientific party to set limits to knowledge and to the powers of the mind. In his essay on "The Relativity of Knowledge," while not at all denying the principle, he condemns the sweeping conclusions that many have been disposed to draw from it, saying, "Relativity as a self-evident and

harmless assertion is made to stand for relativity as an extreme and destructive theory."

The character of the volume is thus intimated by the author: "While the discussions now offered touch very closely the points at issue between the empirical and the intuitive tendencies in philosophy, they are not conducted with any express conformity to either mode of inquiry. There is, in the consideration of these fundamental questions, a distinct recognition of the fact that the phenomena of mind can not find a rational substratum of thought within themselves as phenomena merely, and also a recognition of the fact that it is these very phenomena, and these only, that call for explanation. The effort has been, therefore, to bring appropriate ideas to the interpretation of mental facts, as broadly and fully contained in human experience."

JAPANESE HOMES AND THEIR SURROUNDINGS. By EDWARD S. MORSE. Boston: Ticknor & Co. Pp. 372, with Plates. Price, $5.

PROFESSOR MORSE has achieved a just distinction as an accurate observer in various fields of natural history, whose precision and facility in relation commend the published results of his labors alike to the scientific constituency and to the general reading public. The former class have shown their esteem for him by choosing him to preside at the next meeting of the American Association. He has been for many years Director of the Peabody Academy of Sciences, at Salem, Massachusetts. He visited Japan in 1877 to study the marine fauna of the coast, and, removing there in 1878 with his family, remained nearly two years as Professor of Zoölogy in the Imperial University of Tokio. During this residence he varied his labors with studying the traces of primitive man on the islands and making notes of ethnological and general interest. He afterward made a third visit to the country for the sole purpose of qualifying himself for the preparation of this and other works upon it. Many books have been written about Japan; but few of them have been the result of such patient, careful observation as this. For it the author made several explorations from Yezo to Satsuma, bringing himself into personal communication with the people of all classes, making thorough examinations of their houses, and keeping a daily illustrated journal of all that he saw and all that happened to him. The illustrations in this volume are *fac simile* reproductions of the pen-and-ink drawings he then made. Of the usefulness of such work as he has done here, he expresses a view with which all students of anthropology and of history will concur, when he says he feels that it "has not been altogether in vain, as it may result in preserving many details of the Japanese house—some of them trivial, perhaps—which in a few decades of years may be difficult if not impossible to obtain. . . . Nothing can be of greater importance than the study of those nations and peoples who are passing through profound changes and readjustments as a result of their compulsory contact with the vigorous, selfish, and mercantile nations of the West." The same principle is applicable to all peoples not yet spoiled, and can not be applied too quickly. "If investigators and students would bear in mind the precept of Miyada"—who held it to be a solemn duty to learn any art or accomplishment that might be going out of the world, and then describe it so fully that it might be preserved to posterity—"and seize upon those features in social life—forms of etiquette, games, ceremonies, and other manners and customs—which are the first to change in any contact with alien races, a very important work would be accomplished for the future sociologist." There is much of a practical bearing to be learned from Japanese architecture and decoration; we have in fact acknowledged it by so readily adopting their styles, or awkwardly trying to imitate them. We may criticise the things we do not like in Japan, or any other country not our own, but we should bear in mind that there may be things among ourselves equally objectionable and liable to criticism. But, "in the study of another people one should if possible look through colorless glasses; though, if one is to err in this respect, it were better that his spectacles should be rose-colored than grimed with the smoke of prejudice. The student of ethnology as a matter of policy, if he can put himself in no

more generous attitude, had better err in looking kindly and favorably at a people whose habits and customs he is about to study. It is human nature the world over to resist adverse criticism; and, where one is prowling about with his eyes darkened by the opaquest of uncorrected provincial glasses, he is repelled on all sides; nothing is accessible to him; he can rarely get more than a superficial glance at matters, whereas, if he tries honestly to seek out the better attributes of a people, he is not only welcome to proceed with any investigation he wishes to make; even customs and ways that appear offensive are fully revealed to him, knowing that he will not willfully distort and render more painful what is at the outset admitted on all hands to be bad." In this spirit, which should be applied to other studies as well as those of social customs, the author has endeavored to give an account of Japanese homes and their surroundings. He might have taken the huts of the poorest people or the houses of the wealthy, as his types, but has preferred to make his general descriptions relate to the homes of the middle classes, with occasional references to those of the higher and lower orders. We have already drawn upon the matter of the book for an article in our March number. Further than to refer to that article as a general indication of the way in which the subject is treated, we will say that in the book the various items of household management, rooms, furniture, utensils, tools, gateways, objects of art, etc., are treated in detail in sections, which are monographs in themselves, and adorned with real illustrations; and that we find here and there hints relative to comparative economy, æsthetics, and morals, that point the way to instructive thought.

THE NEW AGRICULTURE; OR, THE WATERS LED CAPTIVE. By A. N. COLE. New York: Anglers' Publishing Company, 252 Broadway. Pp. 224.

MR. COLE describes in this volume a system of drainage and self-irrigation which he has devised and uses at his hill-side home in Allegany County, New York, from which he claims to have obtained astonishing results in an improved condition of the soil, independence of spring frosts and summer drought, and greatly increased yield and quality of crops. The system consists in constructing along the hill-side a series of parallel drains of considerable size, and of depth reaching to below the frost-line. The drains are filled with stones loosely thrown in, and covered with flat stones having above them material for sifting the solid matters from the water. Overflow drains are provided at suitable points for conveying any excess of water to the next lower drain in the series. These drains collect all the water from rain, snow, and dew deposited upon the land above them, and act as reservoirs to hold it till it is drawn out by the needs of the soil in the dry season. From the operation of his system Mr. Cole claims to have realized a fourfold increase of cereal crops, with corresponding improvement in size, flavor, and production of fruits and vegetables; absolute freedom from disease, especially from fungoid affections; security against spring and autumn frosts, with considerable prolongation of the season; the conversion of hard-pan into good soil; prevention of soil-washing; effectual security against drought; and the formation of springs. The plan as described is particularly applicable to hill-side land.

PRICE-LIST OF PUBLICATIONS OF THE SMITHSONIAN INSTITUTION, July, 1885. Washington: Government Printing-Office. Pp. 27.

THIS list includes only the publications of the Institution (1847 to 1885) which can be furnished at the prices named. The publications not mentioned are out of print. The titles are given as they occur in the order in which the works were originally published, classified according to their subjects, by authors, and according to the particular series to which they belong. We are informed that all gratuitous distribution to individuals has been discontinued; but the "Smithsonian Contributions" and "Miscellaneous Collections" are presented to public libraries containing 25,000 volumes, learned societies of the first class, and small public libraries, properly recommended, where a large district would be otherwise unsupplied.

INTERNATIONAL SCIENTIFIC SERIES. VOL. LIII.

THE MAMMALIA IN THEIR RELATION TO PRIMEVAL TIMES. By OSCAR SCHMIDT. New York: D. Appleton & Co. Pp. 308, with Fifty-one Woodcuts. Price, $1.50.

THIS is the last work of the venerable Professor of Zoölogy in the University of Strasburg, the news of his death having arrived since its publication. That there has been a great advance in recent years of our knowledge of the mammalia, especially in relation to primeval conditions, is well known, and Dr. Schmidt in this volume has very ably summarized the most important results of recent research in this field. He published, some years ago, a volume in this series entitled "Doctrine of Descent and Darwinism," which has met with much favor as a contribution to modern philosophical biology. The present book is on the same line of exposition, and is offered by the author as a supplement, rounding up the discussion, while, at the same time, it has the character of a separate treatise. The author says: "It will be found to contain proofs of the necessity, the truth, and the value of Darwinism as the foundation for the theory of descent within a limited field, and is brought down to the most recent times. Within these limits the work is complete in itself; for, although the student of natural history may have become acquainted with interesting fragments of the actual science, still the subject has not before been presented in so comprehensive a manner or in so convenient a form."

PROTECTION *versus* FREE-TRADE. The Scientific Validity and Economic Operation of Defensive Duties in the United States. By HENRY M. HOYT. New York: D. Appleton & Co. Pp. 435. Price, $2.

THE late official head of the Commonwealth of Pennsylvania, Governor Hoyt, has here elaborated a pretty solid book on the general subject of freedom and restriction in commerce. The author is a protectionist, and has written his volume in the interest of that party. Its tone is controversial and lively, whatever may be said of its arguments, and the adherents of the "Pennsylvania System" will be sure to get great comfort out of its perusal. Governor Hoyt is an antagonist of free trade, and, as free trade is grounded in the principles of political economy, Governor Hoyt is also the antagonist of political economy; that is, a large portion of his book is devoted to discrediting the "so-called science" of wealth. As we understand the Governor, he seems to think that, so far as men's exchanges of property are concerned, this world was made much too big. It should have been limited, if not to the boundaries of Pennsylvania, then certainly to the boundaries of the United States; and he thinks, too, our policy should be to correct this blunder in world-making by ignoring anything outside these national limits. His idea appears to be that foreign trade is not profitable, and that we can make more money by being shut in among ourselves and ignoring all other nations. The key to the philosophy of his book is found in its concluding words, which are these, given with the emphasis of italics: "*The nearer we come to organizing our* COMPETING *industries as if we were the only nation on the planet, the more we shall make and the more we shall have to divide among the makers.*" The reason why it is necessary to break down "political economy" and get it out of the way is thus sufficiently apparent.

THE RAISING AND MANAGEMENT OF POULTRY. Boston: Cupples, Upham & Co. Pp. 125.

THIS volume contains a phonographic report of the addresses and discussions that were had at two meetings of poultry experts, in connection with the series of Saturday Farmers Meetings, which were held in Boston May 7 and 14, 1885. The subjects specially considered pertain to the establishment of the best breeds; the qualities of each breed, as an egg and flesh producer; the care and profit of the stock; and the great and increasing value of the poultry interest to farmers and the country.

SCARLET FEVER, AND CERTAIN SUGGESTIONS FOR ITS TREATMENT. By T. GRISWOLD COMSTOCK, M. D., of St. Louis. Pp. 19.

THE author in this paper calls attention to certain therapeutical measures for the treatment of the disease, "which, if not entirely new to some of the profession, are but little used by many, and nevertheless are of great value."

CATHOLIC HISTORICAL RESEARCHES. Quarterly. Edited by Rev. A. A. LAMBING. January, 1886. Pittsburg. Pp. 40. Price, 25 cents a number, $1 a year.

THIS is a new naming, appropriate to the enlarged scope of the "Historical Researches in Western Pennsylvania, Principally Catholic," which the editor began in July, 1884. The publication is intended to contain matters relating to the past history of the Roman Catholic Church in this country; to chronicle the progress of Catholic historical inquiry, giving proceedings and papers of societies; to reproduce original historical documents, registers, letters, etc.; and to contain departments for brief historical notes, inquiries, and replies, with book reviews.

EVOLUTION AND RELIGION. By HENRY WARD BEECHER. New York: Fords, Howard, and Hulbert. Part I. Pp. 145. Price, 50 cents. Part II. Pp. 295. Price, $1.

"THE universal physical fact of evolution, postulated as a theory of the divine method of creation," says Mr. Beecher, "is one which so naturally and simply fits many a puzzling lock, that it is gratefully seized by many who seem to themselves to have been shut out from hope and from the truth. For myself, while finding no need of changing my idea of the divine personality because of new light upon his mode of working, I have hailed the evolutionary philosophy with joy. Some of the applications of its principles to the line of development I have to reject; others, though not proved—and in the present state of scientific knowledge perhaps not even provable—I accept as probable; but the underlying truth, as a law of Nature (that is, a regular method of the divine action), I accept and use, and thank God for it." Mr. Beecher has learned that he has in fact been for fifty years, without knowing it, preaching a doctrine of evolution in its application to a spiritual growth, and now fervently believes that that doctrine is bringing "to the aid of religious truth, as set forth in the life and teachings of Jesus Christ, a new and powerful aid, fully in line with other marked developments of God's providence in his Word." For two years he has preached with specific application of this principle to practical aspects of Christian life. These discourses are incorporated in these two parts of a single work. In the first part are placed eight sermons, discussing the bearings of the evolutionary philosophy on some of the fundamental doctrines of the Christian faith—the divine nature, the question of human sinfulness, the inspiration of the Bible, the divine providence, and correlated subjects. The second part contains eighteen sermons, pointing out the specific application of those general principles, and showing the main lines along which Mr. Beecher believes "the main course of the old ship will largely be laid."

INTROSPECTIVE INSANITY. By ALLAN MCLANE HAMILTON, of New York. Pp. 8.

IN this paper is given a study of a remarkable phase of morbid affections, known to the French as *folie du doute* and to the Germans as *Grubelsucht*, which varies in intensity from mere morbid nervousness or eccentricity to positive insanity. It is described as a condition of mind which is manifested by a morbid feeling of doubt and consequent indecision under the most ordinary circumstances, when both the doubt and indecision are unreasonable in the extreme, but the individual, under the mandate of an imperative conception, yields more or less to his disordered emotions. It appears under numerous aspects, some of which are illustrated by the relation of cases.

ON THE DEVELOPMENT OF CRYSTALLIZATION IN THE IGNEOUS ROCKS OF WASHOE, NEVADA. By ARNOLD HAGUE and JOSEPH P. IDDINGS. Washington: Government Printing-Office. Pp. 44.

IN studying the lavas from the Pacific coast volcanoes, the authors were struck with insensible gradations in the microstructure in the ground-mass of rocks of the same mineral composition from a purely glassy form to one wholly crystalline, and corresponding to a fine-grained granite-porphyry. They were convinced by the chain of microscopical evidence that the glassy and crystalline rocks were simply the extreme forms of the same magma. This pamphlet gives the account of the experiments and investigations.

ERICSSON'S DESTROYER AND SUBMARINE GUN. By WILLIAM H. JAQUES, Lieutenant U. S. Navy. New York: G. P. Putnam's Sons. Pp. 48. Price, 50 cents.

IN his paper on "the Monitors," published in a recent number of "The Century," Captain Ericsson made a reference to his application of submarine artillery to the Destroyer, a vessel of war partially armored to attack bows on at short range. In the present work an examination is made of the submarine gun and projectile to the carrying of which Captain Ericsson adapts the plan of his vessel; and the conclusion is reached that the inventor "is able to present to-day, as the product of his study, application, and mechanical skill, a type of weapon for submarine warfare well to the front in torpedo experiments."

THE EVOLUTION OF REVELATION. By JAMES MORRIS WHITON, Ph. D. New York: G. P. Putnam's Sons. Pp. 34. Price, 25 cents.

THIS essay is declared in its sub-title to be a critique of conflicting opinions concerning the Old Testament. As against the popular conception of that revelation which God is conceived as having made in the Bible, that it is something directly "handed down" from a Divine Author, and therefore superior to the pretensions of criticism, the author maintains a conception which, while it regards revelation as divine, "views it as a growth within the world, an evolution, no less than humanity itself, and no less than man himself a work of God, while also a phenomenon of the orderly development of the world, and, as such, a legitimate object of scientific criticism."

SYLLABUS OF INSTRUCTION IN BIOLOGY, with References to Sources of Information. By DELOS FALL, Albion College, Michigan. Pp. 24.

THE Syllabus is intended to furnish a brief skeleton or abstract of all that is comprehended, in the catalogue of 1885, under the terms Biology, Systematic Zoölogy, and Physiological Botany—except that the botanical part is to be given in a supplementary syllabus. The work will consist of the examination of sixteen type-forms of animals, and a less number of plants, in the philosophical order of complexity of development. The student is expected to collect his own material where it is accessible, to study and observe the object itself, make notes of all he observes, make suitable drawings, and embody the knowledge thus obtained, and no other, in a written essay or statement.

MARLBOROUGH. By GEORGE SAINTSBURY. New York: D. Appleton & Co. Pp. 218. Price, 75 cents.

"MARLBOROUGH" is a volume of the series of "English Worthies," edited by Andrew Lang, of which the Messrs. Appleton are the American publishers. The series will consist of short lives of Englishmen of influence and distinction, past and present, in various walks of life. Each biography will be intrusted to a writer specially acquainted with the historical period in which his hero lived, and endowed with a sympathy with his subject. Of the present volume it is sufficient to say that it is a life of one of the most distinguished English soldiers, by a writer who is well known in the field of literary and biographical sketches.

HOUSEHOLD REMEDIES FOR THE PREVALENT DISORDERS OF THE HUMAN ORGANISM. By FELIX L. OSWALD, M. D. New York: Fowler & Wells Co. Pp. 229.

DR. OSWALD is no stranger to the readers of the "Monthly"; he is rather as a familiar friend to them. And the doctrines which he lays down in "Household Remedies" are the same which he has enforced with so much vigor and point, and with such charming grace of style, in the health papers he has from time to time contributed to our pages. In fact, if we read right, some of these health papers — those which come under the head of "Remedies of Nature" —are the basis from which this book of "Household Remedies" has been constructed.

FIFTH ANNUAL REPORT OF THE STATE MINERALOGIST OF CALIFORNIA, for the Year ending May 15, 1885. Sacramento: State Office. Pp. 235, with Plans.

THE report is mostly taken up with the account of the State minerological representation at the New Orleans Exhibition, to which the plans refer.

WAR AND PEACE. An Historical Novel. By Count LÉON TOLSTOI. New York: W. S. Gottsberger. Two volumes. Pp. 322 and 357.

THIS work will command attention on account of the fame of the author, who, after having for a considerable time held an important official position under the Emperor of Russia, retired from public life and turned his attention to literature. He is now one of the most prominent Russian writers. The story relates to that period of the Napoleonic wars, from 1805 to 1807, which preceded the Peace of Tilsit, and introduces as actors several of the prominent characters of the time. The present edition is a double translation, the story having been first translated from Russian into French by a Russian lady, and then into English by Clara Bell.

MANUAL OF THE BOTANY OF THE ROCKY MOUNTAIN REGION. By JOHN M. COULTER. New York: Ivison, Blakeman, Taylor & Co. Pp. 480.

"WEST of the Mississippi Valley prairie region," says the author of this "Manual," "there are three well-defined floras: One is that of the Pacific slope; another is Mexican in character, extending from the Great Basin to Arizona, New Mexico, Western Texas, and southward into Mexico; the third is the Rocky Mountain region, extending eastward across the plains to the prairies." The first floral region is descriptively provided for in two volumes on the "Botany of California"; the botany of the Great Basin is described in works by Sereno Watson and Dr. Rothrock. The third region was imperfectly described in Professor Porter's "Synopsis of the Flora of Colorado," a first attempt, published about ten years ago. The present volume is an attempt to furnish a more adequate presentation of the subject than could be given at that time, and to provoke still further advance and improvement. The range it is intended to cover includes Colorado, Wyoming, Montana, Western Dakota, Western Nebraska, and Western Kansas. In it are also included the larger part of the contiguous flora, running into the western part of the Indian Territory, Northwestern Texas, Northern New Mexico and Arizona, and Eastern Utah and Idaho, for all except their own peculiar plants. In Utah the range is carried westward by the Uintah and Wahsatch Mountains, whose plants are intended to be included. This edition only claims to be a compilation, and an orderly arrangement and sifting of scattered material — an arrangement and sifting that were greatly needed, for much of the material was practically inaccessible.

STUDIES FROM THE BIOLOGICAL LABORATORY OF JOHNS HOPKINS UNIVERSITY. Baltimore: NEWELL MARTIN, M. D., F. R. S., and W. K. BROOKS, editors. Vol. iii, Nos. 1 to 4. Pp. 216, with Twelve Plates. Price per volume, $5. The price of single numbers varies with the size.

THESE studies, issued from time to time, contain the majority of the original scientific papers published by members of the Biological Department of the University. They will be grouped into volumes of about five hundred pages each. The numbers before us contain eleven papers, giving accounts of special researches into various facts of special structure and function. Among the papers of most general interest are those of Mr. W. H. Howell, on "The Origin of the Fibrin formed in the Coagulation of Blood," and of Mr. H. G. Beyer, "On the Action of Carbolic Acid, Atropia, and Convallaria on the Heart, with some Observations on the Influence of Oxygenated and Non-oxygenated Blood, and of Blood in Various Degrees of Dilution," both of which are in No. 2.

THE LOUISIANA PURCHASE IN ITS INFLUENCE UPON THE AMERICAN SYSTEM. By the Right Reverend C. F. ROBERTSON, D. D. New York: G. P. Putnam's Sons. Pp. 42. Price, 50 cents.

THIS paper, by the Protestant Episcopal Bishop of Missouri, belongs to the series of the American Historical Association. The subject, as the author reviews it briefly, becomes a very broad one—much larger, probably, than most readers are at the beginning ready to suppose it to be. In the first place, the purchase was acknowledged to be extra-constitutional, but then no one, in Congress or out of it, could say anything about that matter while it was under settlement, for fear of giving France a pretext for withdrawing from the bargain. The

acquisition of so large a territory in the Southwest disturbed the balance of the country, caused discontent in New England, and developed a spirit of secession. A connection is traced between some of the results of the purchase and the British blockade acts and our embargo laws. A great impetus was given to the movement of population westward. Miranda's scheme for overthrowing Spanish power in South America and Burr's conspiracy were fed by it. The Texan revolution followed in due time, leading to the consequences of annexation, the Mexican War, and the acquisition of California. From this came a vast accession of wealth, the beginning of the era of large fortunes, and an entire change in American ideas of life, with a vast increase in the sweep and scope of American policy. Parallel with the earlier stages of these events was the taking shape of the Monroe doctrine, involving, among its consequences, the Clayton-Bulwer Treaty, the nullification of the French schemes against Mexico, and the unsolved problems of the future respecting interoceanic transportation over the Isthmus. Other consequences which have resulted or are emerging, made possible by the acquisition of Louisiana, are hinted at, but not considered in detail; but enough is brought forward to show that the theme is one on which much might be written.

A HISTORY OF GERMAN LITERATURE. By W. SCHERER. Translated by Mrs. F. C. Conybeare, and edited by F. MAX MÜLLER. New York: Charles Scribner's Sons. Two volumes. Pp. 401 and 425. Price, $3.50.

THE author of this important history is recognized as an accomplished philologist and a competent literary critic, and as possessing at the same time the gift of attractive popular exposition, thus having the three most desirable qualities for his undertaking. The period embraced in its review begins with the earliest writings, and extends to the death of Goethe. The first chapter traces the roots of German nationality back to the period preceding the Aryan separation, and presents a picture of its intellectual condition at the time it became known to the Romans. The second chapter treats of the rise and development of the German hero-legends in the epoch of the migrations, and during the Merovingian period; the third chapter of the Mediæval Renaissance, the so-called Old High-German period of the Carlovingians and the Ottos. The succeeding four chapters are devoted to the classical period of the Middle High-German lyric and epic poetry, extending from about the eleventh to the middle of the fourteenth century. The next two chapters include the next three centuries, the period of transition from Middle High-German to New High-German, to which Luther's translation of the Bible belongs. The remaining four chapters are devoted to the period in which we live, beginning with the close of the Thirty Years' war, and give especial attention to the development of lyric and epic poetry, from Paul Gerhard to Goethe. The whole is supplemented by a full chronological table of authors and literary works and events, a bibliographical appendix, and an excellent index.

MEN, WOMEN, AND GODS, AND OTHER LECTURES. By HELEN H. GARDENER. With an Introduction by Colonel R. G. INGERSOLL. New York: The Truth-Seeker Company. Pp. 158.

BESIDES a characteristic introduction by Colonel Ingersoll, this book contains three lectures. The first gives the title to the volume; the second is on "Vicarious Atonement"; the third is on "Historical Facts and Theological Fictions." The author speaks from the point of one who regards the teachings of the Bible and the doctrines and practices of the Church regarding women as all wrong, and as lying at the bottom of all the disabilities which she believes woman has suffered in Christian lands. The third lecture embodies replies to certain specific claims that have been made that the Church has contributed to the elevation of woman's life and status.

MECHANICS AND FAITH. A Study of Spiritual Truth in Nature. By CHARLES TALBOT PORTER. New York: G. P. Putnam's Sons. Pp. 295. Price, $1.50.

THE author, as the basis of his theory, regards matter to be force, manifested in endless diversity of application to our nature and wants. "Force, truth, beauty, and love," he says, "are the four spiritual realities which in their unity interpenetrate, if

indeed they do not constitute, all material forms of being. These spiritual realities are revealed directly to the spirit of man, while the forms within which they are contained are made known to him through his physical organs of perception." It is through the recognition of these and correlated truths "that the mind becomes able to perceive the harmony that exists between reason and faith." The author has endeavored to reach these truths and to show this harmony by the aid, primarily, of mechanical science and the analogies which it affords.

FOURTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY. 1882–'83. By J. W. POWELL, Director. Washington: Government Printing-Office. Pp. 473, with Plates.

THE operations of the survey have been extended over the eastern part of the United States, under the authority of a provision in the appropriation act of 1882–'83, requiring it to make a geological map of the United States. The general map is to be made on a scale of $\frac{1}{2500000}$, or four miles to the square inch. Besides the general report of the progress of the work of the survey and the administrative reports of the heads of divisions (embracing geologic, paleontologic, and chemic work), the present volume contains papers on "Hawaiian Volcanoes," by Clarence Edward Dutton; "The Mining Geology of the Eureka District, Nevada," by J. S. Curtis; "Popular Fallacies regarding the Precious Metal Ore Deposits," by Albert Williams, Jr.; "The Fossil Ostreidæ of North America," by Dr. Charles A. White; and "A Geological Reconnaissance in Southern Oregon," by Israel C. Russell.

SOCIAL WEALTH. The Sole Factors and Exact Ratios in its Acquirement and Apportionment. By J. K. INGALLS. New York: The Truth-Seeker Company. Pp. 320. Price, $1.

THE professed purpose of this book is to direct inquiry to questions intimately related to all human life and employment. The author assumes that "we are living under a system of capitalistic aggrandizement or commercial monarchism," and that "our political *savants* offer us nothing but what is most delusive and contradictory, while servilely bowing to the demands of a dominant plutocracy." On the other hand, we have the ideas of the European radicals etc., "with suggestions of revolution and of measures of reform ranging from anarchism to the control of social industry by the state." He thinks there must be some natural relation between the worker and the soil, some principle of law which will give an equitable share of the products of industry to each who shares the labor, and a just principle of agreement and consent in regard to such production and division; and endeavors to discover these principles.

MINERAL RESOURCES OF THE UNITED STATES, Calendar Years 1883 and 1884. By ALBERT WILLIAMS, Jr. Washington: Government Printing-Office. Pp. 1016. Price, 60 cents.

THIS volume is the second of the series. While it bears the same title, with the exception of the date, as the former volume which covered the calendar year 1882, it is not a reprint, or second edition of that report. The tables of production are regiven; but it has been the endeavor to avoid as far as possible a reproduction of the descriptive matter. While some of the main topics discussed in the former volume, concerning which nothing new has been brought out, are omitted, other subjects, which were not adequately discussed before, are now dealt with at considerable length. A considerable number of the articles appear as special contributions, with the authors' names attached.

THE GREEK ISLANDS AND TURKEY AFTER THE WAR. By HENRY M. FIELD, D. D. New York: Charles Scribner's Sons. Pp. 228. Price, $1.50.

THE region of which this book gives the author's views of travel is not only one of the finest of the earth in its scenery, but is also predominantly rich in associations of profane and sacred history and literature and art, which are regarded by the majority of reading people with the warmest interest. It is also becoming the scene of stirring movements of progress and political reconstruction, and thereby a center of great contemporary interest. In describing it as a whole and in its different parts, Dr. Field has an eye to all these points of inter-

est, and gives to each its due place. The book contains chapters on the Island of Cyprus; the shores of Asia Minor; the Archipelago; Smyrna; Mitylene and Troy; Constantinople and the American missions and schools; and the affairs and prospects of Turkey and the new states, with histories of the recent events that have led up to independence or autonomy of the latter.

WONDERFUL ESCAPES. From the French of F. Bernard, with Original Chapters added by RICHARD WHITING. New York: Charles Scribner's Sons. Pp. 306, with full-page Illustrations. Price, $1.

THIS is a volume of the "Illustrated Library of Wonders," of which the publishers are issuing a new and cheap edition. It relates, each story being complete in itself, a number of the most marvelous escapes of persons from extreme danger, of which history is full, beginning with the story of Aristomenes the Messenian, 684 B. C., as related by Pausanias, and closing with the escapes of Louis Napoleon from Ham, and James Stephens, the Fenian, from Richmond Prison. In it we find the narrative of the delivery of the twelve priests by Geoffroy Saint-Hilaire.

THE SPARTAN AND THEBAN SUPREMACIES. By CHARLES SANKEY. Pp. 231, with Maps. THE EARLY HANOVERIANS. By EDWARD E. MORRIS. Pp. 235, with Maps and Plans. New York: Charles Scribner's Sons. Price, $1 each.

THESE volumes belong to the series of "Epochs of History," a series the purpose of which is to select and present in a separate volume, complete in itself, a group of events of such importance as to entitle it to be regarded as an epoch. In the selection of authors for the several volumes, regard has been had to the special qualifications of the writer for the portrayal of the particular period assigned to him. The former volume embraces that period—while the history of Greece was still substantially the history of the world—when Athens had failed to weld her discordant neighbor cities into something like national unity, and the experiment was about to be taken up by the ruder states of Sparta and Thebes in succession, to end in a common downfall under the heels of the Macedonian conqueror. Greece had still great men—the soldiers of Sparta and Thebes, and Socrates—but her time of usefulness was substantially over. This volume shows the progress and the speed of the decline.

The second volume is a logical continuation of the same author's "Age of Anne," and relates to a period which was lively in British politics, and was not without brilliant deeds in the wars of other countries. While the name of the epoch is taken from English history, some of the subjects—the Turkish wars, the War of the Polish Succession, Anson's voyage, and many minor matters—are not usually treated in our school-histories. One of the most acceptable features consists in the literary biographies, among the subjects of which are Leibnitz, Newton, the poets and novelists of the period, Dr. Johnson, Rousseau, and Voltaire. Biographies of the political characters are also given, and the account of the rising known as "the 'Forty-five" has been made very full.

BULLETINS OF THE UNITED STATES GEOLOGICAL SURVEY. Nos. 7 to 14, constituting Vol. II. Washington: Government Printing Office. Pp. 830, with Plates.

No. 7 is a catalogue of geological maps of America, North and South, from 1752 to 1881, containing 924 titles arranged in geographical and chronological order, by Jules Marcou and John Belknap Marcou; No. 8 is a paper "On Secondary Enlargements of Mineral Fragments in Certain Rocks," by R. D. Irving and C. R. Van Hise, in which something like a crystalline growth of minerals is indicated; No. 9 is "A Report of Work done in the Washington Laboratory during the Fiscal Year 1883, 1884," by F. W. Clarke and T. M. Chatard; No. 10 is "On the Cambrian Faunas of North America," relating particularly to the St. John formation, New Brunswick, and the Braintree Argillites, by C. D. Walcott; No. 11 is "On the Quaternary and Recent Mollusca of the Great Basin, with Descriptions of New Forms," by R. Ellsworth Call and C. K. Gilbert; No. 12 is "a Crystallographic Study of the Thinolite of Lake Lahontan," by Edward S. Dana; No. 13 is a sketch of the boundaries of the United States and of the several States and Territories, with an

historical account of the territorial changes, by Henry Gannett; and No. 14 is a paper on the "Physical Characteristics of the Iron-carburets," etc., by Carl Barus and Vincent Stronhal. Except where special provision has been made, the United States Geological Survey has no copies of its publications for gratuitous distribution; but copies of most of its works are on sale at fair prices, the moneys resulting from which are, in accordance with an act of Congress, covered into the Treasury of the United States.

PUBLICATIONS RECEIVED.

A New Logical Machine. By Allan Marquand, Ph. D., Princeton, N. J. Pp. 5, with plate.

International Copyright. By an American. London: Ballantyne, Hanson & Co. Pp. 30.

Did Reis invent a Speaking Telephone? Opinions of Scientific Men. Pp. 18. On Telephone Systems. By Professor Amos E. Dolbear, Tufts College, Mass. Pp. 28.

Bulletin of the Buffalo Society of Natural Sciences, W. C. Barrett, M. D., Corresponding Secretary. Vol. V, No. 1. Pp. 46.

The Study of the Nahuatl Language. Pp. 7. Notes on the Mangue (extinct language). Pp. 22. By Daniel G. Brinton, M. D., Philadelphia.

Notes on the Flora of Eastern Virginia. By Lester F. Ward. Pp. 7.

Convention of the Provincial Educational Association of Nova Scotia. Minutes. A. McKay, Halifax, Secretary. Pp. 70.

The Scholar's Portfolio. Monthly. J. F. Sharp, Editor and Proprietor, Williamsport, Pa. Pp. 8. $1 a year.

Silver and Gold (Papers on Bimetallism). By F. J. Scott, Toledo, O. Pp. 28.

Bulletin of the Chemical Society of Washington. No. 1. A. C. Peale, Secretary. Pp. 28.

Veterinary Bulletin, Agricultural College of Michigan. Pp. 4.

A Few Suggestions for the Prevention of Fires. New York: Home Insurance Company. Pp. 8.

The Selborne Society for the Preservation of Birds, Plants, and Pleasant Places. London: G. A. Musgrave. Pp. 11.

Patriotism and National Defense. By Charles H. Hall, D. D. New York: Society for Political Education. Pp. 43. 25 cents.

Modern Armor for National Defense. By William H. Jaques, U. S. Navy. New York: G. P. Putnam's Sons. Pp. 44. 50 cents.

The Post-mortem Imbibition of Poisons. By George B. Miller, M. D. Pp. 8. The Exhalation of Ozone by Odorous Plants. By Drs. J. M. Anders and G. B. M. Miller. Pp. 8.

River and Harbor Improvement Convention at Tuscaloosa, Ala., November 17, 1885. Proceedings. W. C. Jemison, Tuscaloosa. Pp. 68.

The Lepers of Molokai. By Charles Warren Stoddard. Notre Dame, Ind.: "Ave Maria" Press. Pp. 80. 10 cents.

Letters from a Chimney Corner. Chicago: Fergus Printing Company. Pp. 50.

Education in Japan. Washington: Bureau of Education. Pp. 56.

A Theorem of Maximum Dissipativity; and A New Law of Thermo-Chemistry. By George F. Becker. Pp. 11.

Report of the Connecticut Agricultural Experiment Station for 1885. New Haven. Pp. 139.

Precious Stones. By George F. Kunz. Washington: Government Printing-Office. Pp. 60.

Bement Collection of Minerals, from Notes by Professor Gerhard von Rath. By George F. Kunz. New York. Pp. 11.

Report of the International Electrical Exhibition on Steam-Engines. Pp. 27, with Plates.

Report of the Pathological Department of Norristown Hospital for the Insane, Pennsylvania. Pp. 30.

Report of New York State Reformatory, Elmira. Pp. 46, with Plates.

On the Movement-Cure in China. By D. J. MacGowan, M. D. Pp. 12.

Report of New York Agricultural Experiment Station. Pp. 348.

Bulletin of the United States Geological Survey, Nos. 15 to 23, constituting Vol. III. Washington: Government Printing-Office. Pp. 497.

Evolution: A Scotch Verdict. By Charles F. Deems, LL. D. New York: John W. Lovell Company. Pp. 108. 20 cents.

Easy Lessons in Sanitary Science. By Joseph Wilson, M. D. Philadelphia: P. Blakiston, Son, & Co. Pp. 74. $1.

Our Own Set, a Novel. By Ossip Schubin. New York: William S. Gottsberger. Pp. 280.

Food Materials and their Adulterations. By Ellen H. Richards. Boston: Estes & Lauriat. Pp. 183.

The Chaldean Magician. By Ernst Eckstein. New York: William S. Gottsberger. Pp. 112.

Hobbes. By George Croom Robertson. Edinburgh and London: William Blackwood & Sons. Pp. 240.

Hospital Sisters and their Duties. By Eva C. E. Lückes. Philadelphia: P. Blakiston, Son, & Co. Pp. 164. $1.

Romish Teachings in the Protestant Churches. New York: N. Tibbals & Sons. Pp. 100. 20 cents.

The School-Room Chorus. Compiled by E. V. De Graff. 70th edition. Syracuse, N. Y.: C. W. Bardeen. Pp. 147. 35 cents.

The Adirondacks as a Health Resort. Edited by Joseph W. Stickler. New York: G. P. Putnam's Sons. Pp. 198. $1.

The Life and Genius of Goethe. Edited by F. B. Sanborn. Boston: Ticknor & Co. Pp. 454.

Evolution versus Involution. By Arze Z. Reed. New York: James Pott & Co. Pp 275. $2.50.

What Does History Teach? By John Stuart Blackie. New York: Charles Scribner's Sons. Pp. 123. 75 cents.

Where are We, and whither Tending? By the Rev. M. Harvey. Boston: Doyle & Whittle. Pp. 134. 75 cents.

Poetry as a Representative Art. By George Lansing Raymond. New York: G. P. Putnam's Sons. Pp. 346. $1.75.

An Apache Campaign in the Sierra Madre. By John G. Bourke. New York: Charles Scribner's Son's. Pp. 112. $1.

The Butterflies of the Eastern United States. By G. H. French. Philadelphia: J. B. Lippincott Co. Pp. 402. $2.

A Text-Book of Inorganic Chemistry. By Professor Victor von Richter. Translated by Edgar F. Smith. Philadelphia: P. Blakiston, Son, & Co. Pp. 432. $2.

Report of the Commissioner of Education, 1883–84. Washington: Government Printing-Office. Pp. 943.

Cassell's National Library. No. 1, My Ten Years' Imprisonment. By Silvio Pellico. Pp. 90. No. 2, Childe Harold's Pilgrimage. By Lord Byron. Pp. 192. No. 3, Autobiography of Benjamin

Franklin. Pp. 192. No. 4. The Complete Angler. By Izaak Walton. Pp. 192. No. 5. The Man of Feeling. By Henry Mackenzie. Pp. 191. New York: Cassell & Co. 10 cents each.

Three Years of Arctic Service. By Adolphus W. Greely. New York: Charles Scribner's Sons. 2 vols. Pp. 428 and 444, with Maps and Plates. Sold by subscription.

The Fisheries and Fishery Industries of the United States. By George Brown Goode. Washington: Government Printing-Office. 2 vols. Pp. xx and 895, with 277 Plates.

POPULAR MISCELLANY.

The Study of American Languages.—Dr. D. G. Brinton has published an address, which he recently delivered before the Pennsylvania Historical Society, on the importance of studying American languages. Referring to the prominent place which is given to language in the study of ethnology, he shows that its study is particularly essential in the ethnology of America, for "language is almost our only clew to discover the kinship of those countless scattered hordes who roamed the forests of this broad continent." Through the aid of this study alone, Dr. Brinton says, we have already reached the positive knowledge that most of the area of South America, including the whole of the West Indies, was occupied by three great families of nations, not one of which had formed any important settlement on the northern continent. By similar evidence we know that the tribe which greeted Penn when he landed on the site of Philadelphia was a member of one vast family—the Algonquin stock—whose various clans extended from Carolina to Labrador, and from the easternmost cape of Newfoundland to the peaks of the Rocky Mountains, over 20° of latitude and 50° of longitude. We also know that the general trend of migration in the northern continent has been from north to south, and that this is true of the more nearly civilized as well as of the more savage tribes. But such external information is only a part of what these languages are capable of disclosing, for when rightly used they may reveal the inner life of the aborigine and the origin of his customs, laws, superstitions, and religions. Yet the number of those who are giving attention to the study of them is small. In Germany there are Von Tschudi, who has published a volume on the "Qquichua of Peru"; Dr. Stoll, who makes a specialty of the languages of Guatemala; Mr. Julius Platzmann; and Professor Friedrich Müller; in France, the Count de Charency, M. Lucien Adam, and a few other students; while Maisonneuve has published a commendable series of American grammars. In the United States we have the investigations of the Bureau of Ethnology; Dr. John Gilmary Shea, who began a "Library of American Linguistics"; Mr. Horatio Hale; Dr. J. Hammond Trumbull; Dr. Washington Matthews; the Abbé Cuoq, and others; all of whom have worked without reward or the hope of reward, without external stimulus, and almost without recognition. Dr. Brinton thinks that some of our colleges, learned societies, or patrons of science should offer inducements for this study, and asks the pertinent question, "Shall we have fellowships and professorships in abundance for the teaching of the dead languages and dead religions of another hemisphere, and not one for instruction in those tongues of our own land which live in a thousand proper names around us, whose words we repeat daily, and whose structure is as important to the philosophic study of speech as any of the dialects of Greece or India?"

The Southern Limits of Glacial Action.—Since Mr. H. Carvill Lewis described his tracing of the terminal glacial moraine across Pennsylvania, attention has been called by different observers to what appeared to them local evidences of glacial action in the region south of the line fixed by him. Eleven such spots have been particularly mentioned, one of which is as far south as West Philadelphia. Mr. Lewis has made personal examinations of all these places for the purpose of ascertaining whether the supposed evidences were real, and states, in the paper which he has published on the subject, as the result of his investigations, that he has found no reason to change his definition of the terminal line. In every instance he has found positive evidence of glacial action wanting, and that the marks relied upon by those who have supposed such action, in support of their views, can be amply accounted for as effects of water, or of atmospheric or other agencies than that of glacial ice. The

gravel deposit at West Philadelphia, which Mr. C. E. Hall has regarded as a glacial moraine, "is identical with that which occurs all along the Delaware from Trenton to Wilmington." Even at the Wind Gap, only a short distance south of his moraine line, Mr. Lewis did not see a single scratched or transported bowlder, nor any striæ or other signs of glaciation, although these were abundant three miles away, where they suddenly stopped.

Bacteria and Surgical Lesions. — The positive demonstration of the important factorage of bacterial growths in surgical lesions, says Dr. H. O. Marcy, of Boston, in an address before a section of the American Medical Association, would seem no longer wanting. Its recognition in the evolution of the systems of modern wound-treatment is apparent, yet Dr. Marcy is ready to admit that "many questions of great magnitude remain unsettled, that many subjects connected therewith are shrouded in doubt and obscurity, and that many fields of great promise remain yet for exploration. While this may temper our zeal, and cause us to examine with double caution our premises and conclusions, it can not the less stimulate every thoughtful student to better endeavor and renewed effort." The too commonly held ideas of antiseptic surgery, as consisting of carbolic acid applied as spray, or in dressing, are believed to be "not only superficial and misleading, but distinctly incorrect and injurious." Such imperfect knowledge of any scientific truths must have its fruitage only in evil, leading to a distrust in methods, at the best only half understood, and the results obtained, where protection in wounds has not been secured, are falsely reported in proof that antiseptic surgery is only the fashion of the hour."

Depth of Frozen Arctic Soil.—General Sir J. H. Lefroy communicated to the British Association at its last meeting the results, so far, of researches to ascertain the depth of the permanently frozen soil in the Arctic regions of Siberia and British North America. The depth of the "perpetual ground-ice," as it is called, has been found to be, near Yakutsk, Siberia, three hundred and eighty-two feet. But few actual measurements have been recorded in North America, for the people who possess a perpetually frozen soil do not like to speak of it, for fear that it may be regarded as a stigma against their climate. The greatest thickness of "ground-ice" yet actually measured in America is forty-five feet, as measured by Sir John Richardson in latitude 64° 20′ and longitude 124° 15′ west. There is good reason to believe, however, that within the Arctic Circle in America a thickness of ground-ice is attained much exceeding that at Yakutsk. Lieutenant P. H. Ray, U. S. A., sank a pit near Point Barrow, in 1883, to a depth of thirty-eight feet. At twenty-eight feet from the surface the temperature of the soil was 12° Fahr.; and it was the same at thirty-eight feet. Taking the unit of increase of temperature per unit of depth under-ground as 1° Fahr. for sixty-four feet, Lieutenant Ray provisionally computed the total thickness of the ice at about thirteen hundred feet. The depth to which the summer thaw reaches and its rate of progress are more variable, for they are more dependent on the season and the exposure than the depth of the frozen soil. They must greatly influence the agricultural capabilities of the place. In some respects the existence of a frozen stratum underground may be regarded as rather an advantage than otherwise. The cooling of the surface soil which it effects appears to be a provision to counteract the intense heating power of the sun in the summer months, and to secure a supply of moisture to the roots of cereals when they most require it; so much so that General Lefroy believes that agricultural experience in the Northwest would be in favor of retaining it, even if it were possible to get rid of it.

The Travels of a Storm.—At the meeting of the Royal Meteorological Society held November 18th, Mr. Henry Harries read a paper on "The Typhoon Origin of the Weather over the British Isles during the Second Half of October, 1885," which embodied the first daily tracing which has been made of a storm from the Pacific Ocean to Europe. The author showed by means of daily charts that a typhoon which originated near the Philippine Islands on September

27th passed over Japan and the Aleutian Archipelago, and entered the United States October 10th. Crossing the Rocky Mountain range, it proceeded through the Northern States and Canada to Labrador and Davis Strait. In the Atlantic it was joined on the 18th by another disturbance which had come up from the Atlantic tropics, the junction of the two being followed by a cessation of progressive movement from the 19th to the 25th. During this period a severe gale which passed along the southern counties of England on the morning of the 24th—a storm the forecasting of which was shown to be impossible—was formed. Following in the wake of this storm the parent cyclone reached the French coast on the 27th, its advent being marked by violent gales and extensive floods over the whole of Western and Central Europe and Algeria. Passing through France and the Netherlands, the disturbance showed signs of exhaustion, and on November 1st, in the Baltic, it quietly dispersed, after accomplishing a journey of more than sixteen thousand miles in thirty-six days.

Principles of Holiday Rest.—Writing about "The Misuse of Holidays," Dr. Andrew Wilson remarks that there is a wise method of spending our leisure time, as there is a foolish and body-wearing fashion of dealing with it. Rest, in the holiday sense, does not mean absolute inertness, but repose of the faculties, powers, and energies which are ordinarily exerted in our daily associations. It includes and makes allowance for the bringing into play of fresh muscles, new thoughts, and novel experiences of men, cities, sports, and surroundings at large. To the bringing into play of these new faculties, little used in our usual employments, is added the stimulus of the pure air and fresh scenery among which they are exerted. Hence we understand that holiday rest implies healthy activity of powers which, but for the opportunity it affords, would be apt to lie dormant and unused. In this view of the object of rest it would be a thorough mistake for a busy man not an invalid to bury himself in some dull resort where he will simply languish, without the slightest spark of interest being evoked by his surroundings. Equally erroneous is the ordinary hurried "tour," in which we go with a rush from place to place, gulping down novelties as we would bolt a ten-minute railroad-station dinner, without giving ourselves time adequately to digest anything and really enjoy it. Young people are apt to abuse their holidays by over-exerting themselves at some particular sport or exercise. "It is difficult to overdo exercise in the case of young and healthy people, but the walking tour may nevertheless be overdone, the cycling excursion may be of too extended a nature, and the yachting or boating may be fraught with just a little too much exposure to wind and weather." It is important that the place chosen for spending the holiday be suitable to personal wants and constitution. On these subjects every one has his own taste and his physical and psychical idiosyncrasies, and they should be regarded.

Symbolism of Architectural Ornament and Dancing-Girls.—M. Edmond Fuchs has remarked a connection between the peculiarities in the ornamentation of the ancient Cambodian architecture and the mythology of the builders. While the Egyptians and Greeks looked for their types of beauty in geometrical relations and numerical harmonies, the Indians sought them in the reproduction of living forms. In a balustrade they would represent a serpent stretching itself along perhaps hundreds of yards, with a row of broad-shouldered giants standing at intervals to support it. The form of the same serpent may be found carved on the pediment, its head jutting out at repeated intervals to mark the cornice. The walls of the monuments are covered with bas-reliefs representing theocratic symbols and incidents in the national history; and they are often pregnant with religious admonitions in the shape of representations of the punishments of hell. In the sacred inclosure of the Angkhor Wat, the Kmer sculptor has employed all his skill in depicting the refinements of the tortures to which guilty souls are condemned. A symbol occurring profusely, and which was imposed on the artists by the essential conditions of Oriental life, is that of the dancing-girl, a kind of hieratic character in Indo-China, whose function it was to perpetuate and interpret

by her poses and mimicry the symbols and sacred legends of the ancient literature, the original myths which, having undergone a series of transformations, have gained a foothold in the popular conception and become fairy stories. The myths, the primitive forms of which are fixed by the dancing-girls in the Angkhor bas-reliefs, are the same as are represented in legendary form in the royal festivals, and as may be witnessed by any visitor at the palace of King Norodom I of Cambodia. While a choir of women chant the legends from the ancient sacred poems, other actors silently feign, in postures religiously prescribed by tradition, the emotions they are supposed to feel and the different phases of the drama represented. Thus, they interpret, by the same attitudes as were engraved upon the stone two thousand years ago, the myths and primitive beliefs that were vital in the imagination of the Aryans when they first entered the peninsula.

Effects of Cold on Microbes.—Mr. J. J. Coleman and Professor J. G. McKendrick have been making experiments on the effects of cold upon microphytes. With a mechanical freezer they produced a cold of 80° below zero, and lower, to which they exposed putrescible substances for various lengths of time; then the same substances were exposed to the conditions of temperature, etc., under which putrefaction is developed, and the results were observed. The experiments were made with meats, fresh and canned, wine, milk, beer, ale, meat-juice, neutralized vegetable infusions, putrefying fluids, gelatinous infusions of meat with grape-sugar, etc., in exposure to cold of from 80° to 120° below zero, for from a few hours to a hundred hours or more. The results were in every case substantially the same. The putrefactive process was checked and made slower for a time, but in no case were the micro-organisms so thoroughly destroyed but that putrefaction set in again after a greater or less length of exposure to a temperature favorable to it. The conclusion of the experimenters was that the degree of cold they employed may perhaps be competent to destroy living, developed organisms, but not to kill the germs. A cold-blooded animal —a frog—was frozen solid by a half-hour's exposure to a temperature of from —20° to —30°, but recovered on being thawed out, while after twenty minutes' exposure to —100° it failed to recover. A warm-blooded animal—a rabbit—was not frozen by an hour's exposure to —100°, but its bodily temperature became reduced from 99° to 43°.

Democracy in the High-School.—In a report on city schools, the late Mr. John D. Philbrick accounts for the rapid growth of public sentiment in favor of the high-school, which has not been confined to any one section of the country, by observing that these schools naturally find favor in a democratic community, because they are the most truly democratic of all our institutions. "Nothing is more common than to see pupils, representing the extremes in the social scale, sitting side by side in the high-school classes. I have seen the son of the cultured and wealthy merchant and the son of a very poor immigrant going together from the same class in the grammar-school to the same class in the high-school, the former spending his pocket-money to buy the requisite outfit of clothes and books for the latter. I have seen young ladies coming from families of the first rank, not only in respect to culture and wealth, but also in respect to ancestral pretensions, passing the three-years course in the girls' high-school side by side with the daughter of the laborer and the washer-woman. In a suburban town I have seen the daughter of a wealthy manufacturer procuring by subscription the funds to enable a classmate, the worthy son of a poor Irish farmer, to obtain the clothing needful to make it practicable for him to perform the part assigned him on graduating-day. At this same school on graduating-day I have heard the salutatory address by the daughter of an English immigrant laborer, who can neither read nor write, and the valedictory by the daughter of the wealthiest capitalist in town, while the most meritorious performance on the occasion was by a sister of the young man referred to. This young man, it may be added, who has been during the five or six years since his graduation most industriously at work on his father's little farm, is an ardent friend of the high-school, and he regards the 'idea that education unfits a man for

manual labor as simply nonsensical.' The next neighbor to this young man's father is a man of the same nationality and in similar circumstances, who showed me with no little pride two silver medals which a son and a daughter, now working together in the same shoe-factory, obtained at the high-school. 'But,' said I, 'I have just been reading the writing of a man of learning and influence condemning the free high-school, and arguing that it should be abolished.' 'That man,' he replied, 'I consider an enemy to his country.'"

Two New Zealand Mountains.—Mr. J. H. Kerry Nicholls, while exploring the "King Country" of New Zealand, succeeded in ascending the tabooed volcano of Tongariso, which the Maoris consider it sacrilege to approach. The cluster of cones that marks it forms collectively an almost complete circle, rising from a level plateau about 3,000 feet above the sea; while the burning mountain itself, of wonderfully symmetrical proportions, rises from the bottom of an extensive basin-like depression in the very center of this great circle of cones and extinct craters. At 7,000 feet above the sea the traveler was able to look over the hot, quaking edge of the crater, which is circular, nearly a mile in circumference, and 400 feet deep. Within it was a smaller or inner crater, funnel-shaped, and separated from the larger one only by a narrow slip or ridge. At the bottom of the crater were scattered about huge rocky ridges, from the large fissures of which jets of steam burst forth with a roaring, screeching noise that echoed from the depths below with a wailing sound. "Hot springs sent up streams of boiling water, which, running over the rocks and losing themselves in the hot soil, were sent high into the air again in the form of coiling jets of vapor. Miniature cones of dark, smoking mud rose up in every direction, while around all was a seething fused mass of almost molten soil. In every direction were large deposits of pure yellow sulphur, some of which assumed a rock-like formation. At other places it formed a crust over the steaming earth, and when the thermal action was less intense the glittering yellow crystals covered the ground like a thick frost." From the top of the neighboring great mountain of Ruapehu, 9,250 feet above the sea, "a glorious sight burst upon the view. Peak rose above peak from the dazzling expanse of snow, each towering mass of rock, tinted of a reddish hue, standing out clearly defined against the light-blue sky. Immediately beneath where we stood was a steep precipice which fell perpendicularly for hundreds of feet below, and beneath this again was an enormous circle of jagged rocks marking the outline of a gigantic crater, filled to its brim with snow, which was furrowed into chasms of great depth." Adjoining this great mountain is the Onetapu Desert, or "desert of sacred sand," forming one of the most curious features of the region, which covers a large area of country. "In summer it is parched and dried, and gives life only to a few stunted Alpine plants; and, in the winter months, when the snows cover it, it is both difficult and dangerous to traverse. The desert at the surface is composed entirely of a deposit of scoria, with rounded stones and trachytic bowlders above, while in some places rise enormous lava-ridges. By its formations it would appear as if Ruapehu, when in a state of activity, had distributed its shower of ashes and lava over this wide region; and it would also appear that, at the period at which this extensive deposition of scoria occurred, there must have been growing upon this very spot an extensive forest; for as we rode over the dreary expanse we found the remains of enormous trees, which had been converted into charcoal, as it were, at the time when the fiery ashes swept over them."

Protection against Malaria.—We have already noticed the discovery, by Professors Klebs and Tommasi-Crudelli, of the bacterial germ of malaria in the soil of the Roman Campagna. This discovery disposes of the chemical theories of the origin of malaria, and redeems marshes from the stigma of being its direct producers. There are, in fact, marshes where there is no malarial disease, and, on the other hand, disease rages where there are no marshes. The malarial germ, however, requires a certain degree of moisture for its development, and, as the marshes afford it, when marsh and bacteria are brought together, there is

likely to be ague. The ancient inhabitants of the Campagna cleared it of disease by draining it so dry that the bacteria could not thrive in it. This is considered impracticable at present, and our Roman investigators have turned their attention to the best prophylactics against malarial poison. The universal quinine is good, but there are objections to its constant use, and arsenic, cautiously administered, is suggested as preferable. Professor Tommasi-Crudelli recommends, as an alternative prophylactic, decoction of lemon. The plantation of the eucalyptus appears to have failed. Near Rome, at the "Tre Fontane," where eucalyptus-trees have been grown with a special view to settling the question of their virtue, both the monks who inhabit the monastery and the workmen whom they employ have suffered as much as others. In one summer, when the Campagna was comparatively free from malaria, the inhabitants and servants of the "Tre Fontane" suffered more than the rest. Year before last, Professor Tommasi-Crudelli advised the Italian Government to drain and cover with turf the grounds of the Palazzo Salviati on the Lungara, where the new military college has been built. This was done. The result was that no cases of malarial fever occurred, while on the other side of the road there were several that ended fatally.

Inertia of the Eye and the Brain.—In a paper on the "Inertia of the Eye and the Brain," Mr. James McKeen Cattell, of the University of Leipsic, discusses, in view of the results of experiments which he has made, that part of the process of sensation which concerns the time a light must work on the retina in order that a sensation may be excited. The time is to a considerable extent dependent on the nature of the object and the intensity of the light. It varies with the several colors. Orange gives the quickest impression, and yellow is hardly behind it; next come blue, red, and green; while the retina is least sensitive to violet light, the time for which is from two to three times as long as for orange. When lamp-light is substituted for daylight, the time required for perceiving the colors becomes longer, and the order is changed to orange, red, yellow, violet, and blue. When the intensity of colored light varies, the time increases in arithmetical progression as the intensity decreases in geometrical progression. Applied to the distinction of words and letters, the experiments showed that Roman letters are more quickly perceived than German letters, and that the time is slightly shorter for words than for letters, but longer for long or rare words, and for words in a foreign language. The simplest geometrical forms of the letters seem the easiest to see; all ornaments on the letters hinder; and it is doubtful whether it is advantageous to use the thin lines or two varieties of letters in printing. Our punctuation-marks are hard to see, and Mr. Cattell, believing them to be useless, suggests that they might be replaced by spaces between the words proportionate to the importance of the pause. Some of the letters, as S and C, are hard to recognize in themselves; others, as O, Q, G, and C, are liable to confusion by their similarity of form; while E is "needlessly illegible." The order of distinctness for the small letters is d, k, m, g, h, b, p, w, u, l, j, t, v, z, r, o, f, n, a, x, y, e, i, g, c, s. The letters are slightly more difficult to grasp than the numbers, for every combination of numbers makes a number that gives "sense." Not as many words as letters can be grasped at one time, but three times as many letters, when they make words, and twice as many words when they make a sentence, as when they have no connection. The sentence is taken up as a whole; if it is not grasped, hardly any of the words are read; if it is grasped, the words appear very distinct; and this is also the case when the observer constructs an imaginary sentence from the traces he has taken up. The personal equations were important factors in all the experiments, but they did not materially affect the results as wholes.

The Problem of London Sewage.—The disposition of the sewage of London has been made the subject of the report of a royal commission, but still remains nearly as dark as ever. The one point on which all are agreed is that the present method of turning the sewage and rainfall of the streets into the river near the city is reprehensible from every point of view, but it is almost

impossible to determine upon a method to be substituted for it. The commission have decided that the sewage had best be got rid of at the smallest cost compatible with efficiency. The suspended solid matters are the chief causes of nuisance: they may be almost entirely removed, and the tendency to the accumulation of deposits largely lessened, by precipitation; but the result of discharging an effluent alkalized by lime into the river at the present outfalls is problematical. Precipitation alone would not finally purify the river, but nuisances would still occur in dry weather, and the danger to fish and injury to wells would remain. The precipitation works themselves might be carried on without sensible nuisance at a cost of $1,000,000, or a shilling a head of the population per year, but practically a large part of the value of the sewage for manure would be lost. From two to six thousand acres of land would be required for the further purification of the sewage by being passed through it, after having been clarified with lime. The conclusion of the whole matter is, that while profit must not be expected from the utilization of sewage, yet precipitation and utilization are eminently fitted, when properly applied, to produce a purified effluent; and therefore, that, were certain conditions of population and of sewage always observed, each district could be made self-contained in respect of its sewage, just as it can be in respect of its cemetery. The condition as to population is that the district be limited in numbers and in the area occupied. The conditions as to the sewage are, the extent to which it can be separated from the rainfall, and the degree of freshness in which it is received at the place where it is treated.

A Formosan Sketch.—Mr. E. Colborne Baker, in the Royal Geographical Society, compared the shape of the Island of Formosa to that of a fish. If he likened it to a whale, he said, although he must confess it was not very like a whale, he might be asked to account for the blow-holes of the creature. Those blow-holes actually exist in the north part of the island, in the shape of sulphur pits and caverns, from which a great stream of sulphurous vapor is continually spouting in many parts. Her Britannic Majesty's consul at Tamsui resided within an easy morning's walk of an inactive volcano. The summit was a cradle four hundred yards in diameter, and ten miles off was a spot which was very much favored by the European inhabitants. There was a river of hot water, and not many yards off a cold waterfall. The river was fifteen yards broad and five or six feet deep, while the cold waterfall was fifty or sixty feet in height. The surrounding tract was of course burned ground, where no vegetation could exist; but a quarter of a mile away the flora was luxuriant, and the best pineapples in Formosa, which are the best in the world, were cultivated on the very margin of Avernus.

Mountain-Farming in Norway.—Farming in the mountain-regions of Norway is carried on under difficulties that would discourage an agriculturist bred on our prairies. The steep hills and rocks leave no broad spaces for fields, and the mountaineer, to winter his stock, has to make hay out of the grass that grows on the narrow ledges and in the crevices. If he manages to get a considerable crop off a hill, he will store it in sheds till winter, when he will send it down into the valley in bundles along a strong wire which he has stretched from the foot of the mountain to the top. To dry the hay, poles are planted near the patches, between which ropes or long sticks are laid till a sort of six-barred railing is formed. On these bars the hay is laid, and dried in a most effective manner. Corn is tied in small bundles and impaled on poles placed at intervals in the field. The potato-crop is farmed on a like small scale. The seeds are dropped here and there wherever there is a possibility of their taking root. At one place potatoes were noticed growing on a bowlder, where a soil about eighteen inches deep had gathered or been placed, the whole field being a triangle the sides of which were each about twelve feet in length. Small patches from twenty feet to as many yards square are common; while not unfrequently the corn-fields are but a name, for they meander like a stream in all directions among the huge bowlders and bare rocky hillocks which compose so great a part of the surface of a farm-land. The lands are usually very light. Manuring is not resorted to as

a regular part of the routine. The fields are left from time to time for three or four years, by rotation, in grass. In the summer months, female servants, or the daughters of the farmer, tend the cattle high up in the *fjeld*, living in *sæters* or cabins, where they prepare cheese and butter. But this isolation of the young women is sometimes attended with serious moral disadvantages.

The Coral-Harvest.—The most productive coral-beds, which also yield the best and handsomest corals, are on the Algerian coast, and have been fished upon since the middle of the sixteenth century. Other beds are on the coasts of Sicily, Sardinia, Corsica, Spain, the Balearic Islands, and Provence. More than five hundred Italian vessels, with 4,200 men, are engaged in the coral-fishery, and collect annually 56,000 kilogrammes of coral, the value of which is calculated at 4,200,000 lire ($840,000). Besides these, 22,000 kilogrammes, worth 150,000 lire ($30,000), are collected in French, Spanish, and other boats, making the whole annual product 78,000 kilogrammes, and its value 5,750,000 lire ($1,150,000). The taxes which the Government exacts for the privilege of fishing on the African coast amount to 1,160 lire a boat in the summer and half as much in the winter, and this, taking into consideration the toil and danger of the fishery, reduces the profits to a quite modest rate. Estimating the gross returns per boat at 8,000 lire, and the cost at 6,033 lire, we have a net profit of 1,967 lire ($393.40). There are some sixty establishments in Italy where coral is worked up, forty of which are in Torre del Greco, and at which 9,200 hands, chiefly women and children, are employed. The principal markets for the coral are Germany, England, Russia, Austria, Hungary, and Poland; and considerable quantities are sent to Madras and Calcutta.

Advantages of Low Ceilings.—Rooms with low ceilings, or with ceilings even with the window-tops, are more readily and completely ventilated than those with high ceilings. The leakage of air which is always going on keeps all parts of the air in motion in such rooms, whereas if the ceiling is higher, only the lower part of the air is moved, and an inverted lake of foul and hot air is left floating in the space above the window-tops. To have the currents of fresh air circulating only in the lower parts of the room, while the upper portion of the air is left unaffected, is really the worst way of ventilating; for the stagnant atmospheric lake under the ceiling, although motionless, keeps actively at work under the law of the diffusion of gases, fouling the fresh currents circulating beneath it. With low ceilings and high windows no such accumulation of air is possible; for the whole height of the room is swept by the currents as the dust of the floor is swept with a broom. Low ceilings have also the advantage of enabling the room to be warmed with less expenditure of heat and less cost for fuel.

NOTES.

A MINE of mercury—consisting of the sulphuret and chloride, with drops of metallic mercury, in a gangue of quartz—which appears to have been worked in ancient times, has been rediscovered at Schuppiastena, near Belgrade, in Servia.

ADDITIONAL interest will be given to the coming meeting of the British Association at Birmingham, to be opened September 1st, by the exhibition of local manufactures which is to be held in connection with it. Similar exhibitions have been held on each of the three previous occasions when the Association met in Birmingham, in 1838, 1849, and 1865; and it is said that all of the international and other exhibitions which have since been held had their origin and prime model in the first of these; and that the Great International Exhibition of 1851 was suggested to Prince Albert by his visit to Birmingham in 1849. The coming exhibition will be more extensive and varied than any of the previous ones.

M. E. RIVIÈRE has discovered a new station or workshop of the neolithic age in the wood of Clamart, near the gates of Paris. He has recovered from it nearly nine hundred flints (from nodules in chalk), cut or broken by the hand, all of which lay on or near the surface of the ground. Among them are pieces of polished hatchets, scrapers (some very handsome ones), blades, points, and two or three little polishers.

ARTIFICIAL lithographic stones are manufactured in Frankfort by M. Rosenthal from cement, which is put for the purpose through a course of very careful manipulations.

THE Art Schools of the Metropolitan Museum are now established under the immediate supervision of Mr. John Ward Stimson, of the Paris School of Fine Arts, at 214 East Thirty-fourth Street. Eight courses in the fine arts, decorative work, and mechanical drawing are taught by as many instructors, at prices for tuition ranging from $10 to $15 per term (October 5, 1885, to May 1, 1886).

THE Director of the Observatory of Harvard College, besides recording in his annual report the progress of the regular work of the observatory, describes the observations of Professor W. M. Davis and Mr. A. McAdie on the height and velocity of clouds. The observers, stationing themselves at different spots, and communicating by telephone, undertook to make simultaneous azimuth observations upon identical points in the clouds. About three hundred pairs of measures were made in the spring of 1885, with generally satisfactory results. The altitudes determined varied from 2,000 to 25,000 feet; for altitudes less than 8,000 feet the variation between the measures was generally within five per cent of the height. In one instance, cumulative observations of a single cumulus-cloud showed its base to be 4,500 feet high; its summit rose from the height of 6,750 to that of 7,300 feet at the rate of 200 feet a minute, while the cloud drifted to south 43° east at the rate of twenty-seven and a half miles an hour.

"BOWLDER MOSAICS" is what Professor J. E. Todd calls certain figures formed by piling bowlders which he has observed on some ridges in Dakota. One is a gigantic figure of a turtle about fifteen feet long. Another specimen is a figure of a snake, one hundred and twenty paces long, composed like the former of bowlders from four to six inches in diameter. "The eyes are much more expressive than it would at first seem possible to make them with such material. They have literally a 'stony' stare." Few similar figures have been seen elsewhere than at these two spots, but two cases are cited of structures showing geometrical designs. Rude sketches of animals on a smaller scale are also found near Pipestone, Minnesota, chipped or pecked on the smooth surface of the red quartzite. In these the turtle is a favorite figure. Similarly made figures, but quite imperfect, were noticed on Wolf Creek, southwest of Bridgewater, Dakota.

A SPECIAL committee of the Prison Association of New York, appointed to examine the question of the best mode of employing convict-labor, has formulated its conclusions in resolutions which set forth that the highest test of excellence in any system of convict-labor is to be found in the adaptability of that system to promote the end of the convicts' reformation; that the contract system, in principle and in practical methods, is inconsistent with those forms of discipline and treatment that are most conducive to that object, and should therefore be condemned; that the best and most natural method is in the manufacture of supplies for use in institutions supported by the State, and in such other public work for use of the State as can be carried on in confinement; and that State prisoners should be employed on work of that kind, or, if it could not be provided for all, upon the piece-price plan.

IN regard to the length of the range of vision, Mr. A. Shaw Page relates two instances in which he saw the Mourne Mountains of Ireland—which are 2,798 feet high—from Blackpool, England, one hundred and twenty-five miles away.

OBITUARY NOTES.

MR. JAMES FERGUSSON, an eminent English writer on historical and prehistorical architecture, died, January 9th, in his seventy-eighth year. He was a native of Ayr, in Scotland. He was best known by his "History of Architecture," which has gone through many editions, and is accepted as standard. He is remembered in archæology for the help he offered, in suggestions, etc., in the study of the rock-cut temples of India, and in explaining the meaning of Mr. Layard's discoveries at Nineveh, Schliemann's at Troy, Mycenæ, and Tiryns, and in the ideal restorations of the temples at Jerusalem and Ephesus, as well as by his books on "Rude Stone Monuments" and "Tree and Serpent Worship." He served his Government in 1857 as a member of the Royal Commission to inquire into the defenses of the United Kingdom; and in science he contributed a paper on "The Delta of the Ganges and the Natural Laws regulating the Course of Great Rivers."

M. DE SAINT-VENANT, the "Dean" of the Mechanical Section of the French Academy of Sciences, died at Vendôme, on the 6th of January, in the ninetieth year of his age. He preserved his bodily vigor and working capacity till very near the time of his death.

THE death is reported of Dr. Oscar Schmidt, Professor of Zoölogy in the University of Strasburg, and formerly occupant of the same chair at Cracow and Gratz, at the age of sixty-two. He was the author of the treatise on "The Doctrine of Descent and Darwinism," and of the recently published "The Mammalia in their Relation to Primeval Times," in the "International Scientific Series."

SUPPLEMENT.

DAWN OF CREATION AND OF WORSHIP.

REPLY TO DR. RÉVILLE.

By WILLIAM E. GLADSTONE.

AMONG recent works on the origin and history of religions by distinguished authors, a somewhat conspicuous place may be awarded to the "Prolégomènes de l'Histoire des Religions,"* by Dr. Réville, Professor in the College of France, and Hibbert Lecturer in 1884. The volume has been translated into English by Mr. Squire, and the translation* comes forth with all the advantage, and it is great, which can be conferred by an introduction from the pen of Professor Max Müller. It appears, if I may presume to speak of it, to be characterized, among other merits, by marked ingenuity and acuteness, breadth of field, great felicity of phrase, evident candor of intention, and abundant courtesy.

Whether its contents are properly placed as *prolegomena* may at once be questioned; for surely the proper office of *prolegomena* is to present preliminaries, and not results. Such is not, however, the aim of this work. It starts from assuming the subjective origin of all religions, which are viewed as so many answers to the call of a strong human appetite for that kind of food, and are examined as the several varieties of one and the same species. The conclusions of opposing inquirers, however, are not left to be confuted by a collection of facts and testimonies drawn from historical investigation, but are thrust out of the way beforehand in the preface (for, after all, *prolegomena* can be nothing but a less homely phrase for a preface). These inquirers are so many pretenders, who have obstructed the passage of the rightful heir to his throne, and they are to be put summarily out of the way, as disturbers of the public peace. The method pursued appears to be not to allow the facts and arguments to dispose of them, but to condemn them before the cause is heard. I do not know how to reconcile this method with Dr. Réville's declaration that he aims (p. vi) at proceeding in a "strictly scientific spirit." It might be held that such a spirit required the regular presentation of the evidence before the delivery of the verdict upon it. In any case I venture to observe that these are not truly *prolegomena*, but *epilegomena* to a History of Religions not yet placed before us.

The first enemy whom Dr. Réville dispatches is M. de Bonald, as the champion of the doctrine that "in the very beginning of the human race the creative power revealed to the first men by supernatural means the essential principles of religious truth," together with "language and even the art of writing" (pp. 35, 36).

In passing, Dr. Réville observes that "the religious schools, which maintain the truth of a primitive revelation, are guided by a very evident theological interest" (ibid.): the Protestant, to fortify the authority of the Bible; and the Roman Catholic, to prop the infallibility of the Church.

It is doubtless true that the doctrine of a primitive revelation tends to fortify the authority of religion. But is it not equally true, and equally obvious, that the denial of a primitive revelation tends to undermine it? and, if so, might it not be retorted upon the school of Dr. Réville that the schools which deny a primitive revelation are guided by a very evident anti-theological interest?

Against this antagonist Dr. Réville observes, *inter alia* (p. 37), that an appeal to the supernatural is *per se* inadmissible; that a divine revelation, containing the sublime doctrines of the purest inspiration, given to man at an age indefinitely remote, and in a state of "absolute ignorance," is "infinitely hard" to imagine; that it is not

* In his "Prolegomena to the History of Religions." My references throughout are to the translation by Mr. Squire (Williams & Norgate, 1884).

favored by analogy; and that it contradicts all that we know of prehistoric man (p. 40). Thus far it might perhaps be contended in reply, (1) that the preliminary objection to the supernatural is a pure *petitio principii*, and wholly repugnant to "scientific method"; (2) that it is not inconceivable that revelation might be indefinitely graduated, as well as human knowledge and condition; (3) that it is in no way repugnant to analogy, if the greatest master of analogy, Bishop Butler,* may be heard upon the subject; and (4) that our earliest information about the races from which we are least remote, Aryan, Semitic, Accadian, or Egyptian, offers no contradiction and no obstacle to the idea of their having received, or inherited, portions of some knowledge divinely revealed.

But I do not now enter upon these topics, as I have a more immediate and defined concern with the work of Dr. Réville.

It only came within the last few months to my knowledge that, at a period when my cares and labors of a distinct order were much too absorbing to allow of any attention to archæological history, Dr. Réville had done me the honor to select me as the representative of those writers who find warrant for the assertion of a primitive revelation in the testimony of the Holy Scriptures.

This is a distinction which I do not at all deserve: first, because Dr. Réville might have placed in the field champions much more competent and learned † than myself; secondly, because I have never attempted to give the proof of such a warrant. I have never written *ex professo* on the subject of it; but it is true that in a work published nearly thirty years ago, when destructive criticism was less advanced than it now is, I assumed it as a thing generally received, at least in this country. Upon some of the points, which group themselves round that assumption, my views, like those of many other inquirers, have been stated more crudely at an early, and more maturely at more than one later period. I admit that variation or development imposes a hardship upon critics, notwithstanding all their desire to be just; especially, may I say, upon such critics as, traversing ground of almost boundless extent, can hardly, except in the rarest cases, be minutely and closely acquainted with every portion of it.

I also admit to Dr. Réville, and indeed I contend by his side, that in an historical inquiry the authority of Scripture can not be alleged in proof of the existence of a primitive revelation. So to allege it is a preliminary assumption of the supernatural, and is in my view a manifest departure from the laws of "scientific" procedure: as palpable a departure, may I venture to say? as that preliminary exclusion of the supernatural which I have already presumed to notice. My own offense, if it be one, was of another character; and was committed in the early days of Homeric study, when my eyes perhaps were dazzled with the amazing richness and variety of the results which reward all close investigation of the text of Homer, so that objects were blurred for a time in my view, which soon came to stand more clear before me.

I had better perhaps state at once what my contention really is. It is, first, that many important pictures drawn, and indications given, in the Homeric poems supply evidence that can not be confuted not only of an ideal but of an historical relationship to the Hebrew traditions, (1) and mainly, as they are recorded in the Book of Genesis; (2) as less authentically to be gathered from the later Hebrew learning; and (3) as illustrated from extraneous sources. Secondly, any attempt to expound the Olympian mythology of Homer by simple reference to a solar theory, or even to Nature-worship in a larger sense, is simply a plea for a verdict against the evidence. It is also true that I have an unshaken belief in a Divine Revelation, not resting on assumption, but made obligatory upon me by reason. But I hold the last of these convictions entirely apart from the others, and I derived the first and second not from preconception, of which I had not a grain, but from the poems themselves, as purely as I derived my knowledge of the Peloponnesian War from Thucydides or his interpreters.

The great importance of this contention I do not deny. I have produced in its favor

* "Analogy," part ii, chap. ii, § 2.

† I will only name one of the most recent, Dr. Reusch, the author of "Bibel und Natur" (Bonn, 1876).

a great mass of evidence, which, as far as I have seen, there has been no serious endeavor, if indeed any endeavor, to repel. Dr. Réville observes that my views have been subjected to "very profound criticism" by Sir G. Cox in his learned work on Aryan mythology (p. 41). That is indeed a very able criticism; but it is addressed entirely to the statements of my earliest Homeric work.* Now, apart from the question whether those statements have been rightly understood (which I can not admit), that which he attacks is beyond and outside of the proposition which I have given above. Sir G. Cox has not attempted to decide the question whether there was a primitive revelation, or whether it may be traced in Homer. And I may say that I am myself so little satisfied with the precise form in which my general conclusions were originally clothed that I have not reprinted and shall not reprint the work, which has become very rare, only appearing now and then in some catalogue, and at a high price. When there are representatives living and awake, why disturb the ashes of the dead? In later works, reaching from 1865 to 1875,† I have confessed to the modification of my results, and have stated the case in terms which appear to me, using the common phrase, to be those yielded by the legitimate study of comparative religion. But why should those, who think it a sound method of comparative religion to match together the Vedas, the Norse legends, and the Egyptian remains, think it to be no process of comparative religion to bring together, not vaguely and loosely, but in searching detail, certain traditions of the Book of Genesis and those recorded in the Homeric poems, and to argue that their resemblances may afford proof of a common origin, without any anticipatory assumption as to what that origin may be?

It will hardly excite surprise, after what has now been written, when I say I am unable to accept as mine any one of the propositions which Dr. Réville (pp. 41, 42) affiliates to me. (1) I do not hold that there was a "systematic" or willful corruption of a primitive religion. (2) I do not hold that all the mythologies are due to any such corruption systematic or otherwise. (3) I do not hold that no part of them sprang out of the deification of natural facts. (4) I do not hold that the ideas conveyed in the Book of Genesis, or in any Hebrew tradition, were developed in the form of dogma, as is said by Sir G. Cox,* or in "six great doctrines" as is conceived by Dr. Réville; and (5) I am so far from ever having held that there was a "primitive orthodoxy" revealed to the first men (p. 43) that I have carefully from the first referred not to developed doctrine, but to rudimentary indications of what are now developed and established truths. So that, although Dr. Réville asks me for proof, I decline to supply proofs of what I disbelieve. What I have supplied proofs of is the appearance in the Poems of a number of traits, incongruous in various degrees with their immediate environment, but having such marked and characteristic resemblances to the Hebrew tradition as to require of us, in the character of rational inquirers, the admission of a common origin, just as the markings, which we sometimes notice upon the coats of horses and donkeys, are held to require the admission of their relationship to the zebra.

It thus appears that Dr. Réville has discharged his pistol in the air, for my Homeric propositions involve no assumption as to a revelation contained in the Book of Genesis, while he has not *ex professo* contested my statements of an historical relationship between some traditions of that book and those of the Homeric poems. But I will now briefly examine (1) the manner in which Dr. Réville handles the Book of Genesis, and (2) the manner in which he undertakes, by way of specimen, to construe the mythology of Homer, and enlist it, by comparison, in the support of his system of interpretation. And first with the first-named of these two subjects.

Entering a protest against assigning to the Book "a dictatorial authority," that is, I presume, against its containing a Divine

* "Studies on Homer and the Homeric Age," 3 vols. Oxford, 1858.

† "Address to the University of Edinburgh" (Murray, 1865); "Juventus Mundi" (Macmillan, 1868); "Primer of Homer (Macmillan, 1878); especially see Preface to "Juventus Mundi," p. 1.

* "Aryan Mythology," vol. i, p. 15.

revelation to anybody, he passes on to examine its contents. It contains, he says, scientific errors, of which (p. 42, *n.*) he specifies three. His charges are that (1) it speaks of the heaven as a solid vault; (2) it places the creation of the stars after that of the earth, and so places them solely for its use; (3) it introduces the vegetable kingdom before that kingdom could be subjected to the action of solar light. All these condemnations are quietly enunciated in a note, as if they were subject to no dispute. Let us see.

As to the first: if our scholars are right in their judgment, just made known to the world by the recent revision of the Old Testament, the "firmament" is, in the Hebrew original,* *not* a solid vault, but an expanse. As to the second (*a*), it is *not* said in the sacred text that the stars were made solely for the use of the earth; (*b*) it is true that no other use is mentioned. But we must here inquire what was the purpose of the narrative? Not to rear cosmic philosophers, but to furnish ordinary men with some idea of what the Creator had done in the way of providing for them a home and giving them a place in nature. The advantage afforded by the stars to them is named alone, they having no interest in any other purpose for which the stars may exist.

The assertion that the stars are stated to have been "created" after the earth is more serious. But here it becomes necessary first of all to notice the recital in this part of the indictment. In the language of Dr. Réville, the Book speaks of the creation of the stars after the formation of the earth. Now, curiously enough, the Book says nothing either of the "formation" of the earth, or of the "creation" of the stars. It says in its first line that "in the beginning God created the heaven and the earth." It says further on,† "He made the stars also." Can it be urged that this is a fanciful distinction between creating on the one hand and making, forming, or fashioning on the other? Dante did not think so, for, speaking of the Divine Will, he says:

"Ciò ch' Ella cria, e che Natura face." ‡

Luther did not think so, for he uses *schuf* in the first verse, and *machte* in the sixteenth. The English translators and their revisers did not think so, for they use the words "created" and "made" in the two passages respectively. The main question, however, is, What did the author of the Book think, and what did he intend to convey? The LXX drew no distinction, probably for the simple reason that, as the idea of creation proper was not familiar to the Greeks, their language conveyed no word better than *poiein* to express it, which is also the proper word for fashioning or making. But the Hebrew, it seems, had the distinction, and by the writer of Genesis i it has been strictly, to Dr. Réville I might also say scientifically, followed. He uses the word "created" on the three grand occasions (1) of the beginning of the mighty work (v. 1); (2) of the beginning of animal life (v. 21), "And God created great whales," and every living creature that peoples the waters; (3) of the yet more important beginning of rational and spiritual life; "so God created man in his own image" (v. 27). In every other instance, the simple command is recited, or a word implying less than creation is employed.

From this very marked mode of use, it is surely plain that a marked distinction of sense was intended by the sacred writer. I will not attempt a definition of the distinction further than this, that the one phrase points more to calling into a separate or individual existence, the other more to shaping and fashioning the conditions of that existence; the one to *quid*, the other to *quale*. Our Earth, created in v. 1, undergoes structural change, different arrangement of material, in v. 9. After this, and in the fourth day, comes not the original creation, but the location in the firmament, of the sun and the moon. Of their "creation" nothing particular has been said; for no use, palpable to man, was associated with it before their perfect equipment. Does it not seem allowable to suppose that in the "heavens"*

* The στερέωμα of the Septuagint is construed in conformity with the Hebrew.

† Gen. i, 16.

‡ "Paradiso," iii, 87.

* In our translation, and in the recent revision, the singular is used. But we are assured that the Hebrew word is plural (Bishop of Winchester on Genesis i, 1, in the Speaker's Bible). If so taken, we have the creation, visible to us, treated conjointly in verses 1–5, distributively in verses 6–19; surely a most orderly arrangement.

(v. 1), of which after the first outset we hear no more, were included the heavenly bodies? In any case what is afterward conveyed is not the calling into existence of the sun and moon, but the assignment to them of a certain place and orbit respectively, with a light-giving power. Is there the smallest inconsistency in a statement which places the emergence of our land, and its separation from the sea, and the commencement of vegetable life, before the final and full concentration of light upon the sun, and its reflection on the moon and the planets? In the gradual severance of other elements, would not the severance of the luminous body, or force, be gradual also? And why, let me ask of Dr. Réville, as there would plainly be light diffused before there was light concentrated, why may not that light diffused have been sufficient for the purposes of vegetation? There was soil, there was atmosphere, there was moisture, there was light. What more could be required? Need we go beyond our constant experience to be aware that the process of vegetation, though it may be suspended, is not arrested, when, through the presence of cloud and vapor, the sun's globe becomes to us invisible? The same observations apply to the light of the planets; while, as to the other stars, such as were then perceptible to the human eye, we know nothing. The planets, being luminous bodies only through the action of the sun, could not be luminous until such a degree of light, or of light-force, was accumulated upon or in the sun as to make them luminous, instead of being

> "Silent as the moon,
> When she deserts the night
> Hid in her vacant interlunar cave."*

Is it not, then, the fact, thus far, that the impeachment of the Book has fallen to the ground? There remains to add only one remark, the propriety of which is, I think, indisputable. Easy comprehension and impressive force are the objects to be aimed at in a composition at once popular and summary; but these can not always be had without some departure from accurate classification and the order of minute detail. It seems much more easy to justify the language of the opening verses of Genesis than, for example, the convenient usage by which we affirm that the sun rises, or mounts above the horizon, and sets, or descends below it, when we know perfectly well that he does neither the one nor the other. As to the third charge of scientific error, that the vegetable kingdom appeared before it could be subjected to the action of solar light, it has been virtually disposed of. If the light now appropriated to the sun alone was gradually gathering toward and round him, why may it not have performed its proper office in contributing to vegetation when once the necessary degree of severance between solid and fluid, between wet and dry, had been effected? And this is just what had been described in the formation of the firmament, and the separation of land from sea.

More singular still seems to be the next observation offered by Dr. Réville in his compound labor to satisfy his readers, first, that there is no revelation in Genesis, and secondly that, if there be, it is one which has no serious or relevant meaning. He comes to the remarkable expression in v. 26, "Let *us* make man in our own image." There has, it appears, been much difference of opinion even among the Jews on the meaning of this verse. The Almighty addresses, as some think, His own powers; as others think, the angels; others, the earth; other writers, especially, as it appears, Germans, have understood this to be a plural of dignity, after the manner of kings. Others, of the rationalizing school, conceive the word Elohim to be a relic of polytheism. The ancient Christian interpreters,* from the Apostle Barnabas onward, find in these words an indication of a plurality in the Divine Unity. Dr. Réville (p. 43) holds that this is "simply the royal plural used in Hebrew as in many other languages," or else, and more probably, that it is an appeal to the Bené Elohim or angels. But is not this latter meaning a direct assault upon the supreme truth of the Unity of God? If he chooses the former, from whence does he derive his knowledge that this "royal plural" was used in Hebrew? Will the royal plural account for (Gen. iii, 22) "when the man is become as one of us"? and would

* "Samson Agonistes."

* On this expression, I refer again to the commentary of Bishop Harold Browne. Bishop Mant supplies an interesting list of testimonies.

George the Second, if saying of Charles Edward "the man is become as one of us," have intended to convey a singular or a plural meaning? Can we disprove the assertion of Bishop Harold Browne, that this plurality of dignity is unknown to the language of Scripture? And further, if we make the violent assumption that the Christian Church with its one voice is wrong and Dr. Réville right, and that the words were not meant to convey the idea of plurality, yet, if they have been such as to lead all Christendom to see in them this idea through 1800 years, how can he be sure that they did not convey a like signification to the earliest hearers or readers of the Book of Genesis?

The rest of Dr. Réville's criticism is directed rather to the significance or propriety, than to the truth, of the record. It is not necessary to follow his remarks in detail, but it will help the reader to judge how far even a perfectly upright member of the scientific and comparative school can indulge an unconscious bias, if notice be taken in a single instance of his method of comparing. He compares together the two parts of the prediction that the seed of the woman shall bruise the head of the serpent, and that the serpent shall bruise the heel of the seed of the woman (iii, 15); and he conceives the head and the heel to be so much upon a par in their relation to the faculties and the vitality of a man that he can find here nothing to indicate which shall get the better, or, in his own words, "on which side shall be the final victory" (p. 45). St. Paul seems to have taken a different view when he wrote, "the God of peace shall bruise Satan under your feet shortly" (Rom. xvi., 20).

Moreover, "our author" (in Dr. Réville's phrase) is censured because he "takes special care to point out" (p. 44) "that the first pair are as yet strangers to the most elementary notions of morality," inasmuch as they are unclothed, yet without shame; nay, even, as he feelingly says, "without the least shame." In what the morality of the first pair consisted, this is hardly the place to discuss. But let us suppose for a moment that their morality was simply the morality of a little child, the undeveloped morality of obedience, without distinctly formed conceptions of an ethical or abstract standard. Is it not plain that their feelings would have been exactly what the Book describes (Gen. ii, 25), and yet that in their loving obedience to their Father and Creator they would certainly have had a germ, let me say an opening bud, of morality? But this proposition, taken alone, by no means does justice to the case. Dr. Réville would probably put aside with indifference or contempt all that depends upon the dogma of the Fall. And yet there can be no more rational idea, no idea more palpably sustained, whether by philosophy or by experience. Namely, this idea: that the commission of sin, that is, the act of deliberately breaking a known law of duty, injures the nature and composition of the being who commits it. It injures that nature in deranging it, in altering the proportion of its parts and powers, in introducing an inward disorder and rebellion of the lower against the higher, too mournfully corresponding with that disorder and rebellion produced without, as toward God, of which the first sin was the fountain head. Such is, I believe, the language of Christian theology, and in particular of St. Augustine, one of its prime masters. On this matter I apprehend that Dr. Réville, when judging the author of Genesis, judges him without regard to his fundamental ideas and aims, one of which was to convey that before sinning man was a being morally and physically balanced, and nobly pure in every faculty; and that, by and from his sinning, the sense of shame found a proper and necessary place in a nature which before was only open to the sense of duty and of reverence.

One further observation only. Dr. Réville seems to "score one" when he finds (Gen. iv, 26) that Seth had a son, and that "then began men to call on the name of the Lord"; "but not," he adds, "as the result of a recorded revelation." Here at last he has found, or seemed to find, the beginning of religion, and that beginning subjective, not revealed. So hastily, from the first aspect of the text, does he gather a verbal advantage, which, upon the slightest inquiry, would have disappeared like dew in the morning sun. He assumes the rendering of a text which has been the subject of every kind of question and dispute, the only

thing apparently agreed on being that his interpretation is wholly excluded. Upon a disputed original, and a disputed interpretation of the disputed original, he founds a signification in flat contradiction to the whole of the former narrative, to Elohist and Jehovist alike; which narrative, if it represents anything, represents a continuity of active reciprocal relation between God and man both before and after the transgression. Not to mention differences of translation, which essentially change the meaning of the words, the text itself is given by the double authority of the Samaritan Pentateuch * and of the Septuagint in the singular number, which of itself wholly destroys the construction of Dr. Réville. I do not enter upon the difficult question of conflicting authorities, but I urge that it is unsafe to build an important conclusion upon a seriously controverted reading.†

There is nothing, then, in the criticisms of Dr. Réville but what rather tends to confirm than to impair the old-fashioned belief that there is a revelation in the Book of Genesis. With his argument outside this proposition I have not dealt. I make no assumption as to what is termed a verbal inspiration, and, of course, in admitting the variety, I give up the absolute integrity of the text. Upon the presumable age of the book and its compilation I do not enter—not even to contest the opinion which brings it down below the age of Solomon—beyond observing that in every page it appears from internal evidence to belong to a remote antiquity. There is here no question of the chronology or of the date of man, or of knowledge or ignorance in the primitive man; or whether the element of parable enters into any portion of the narrative; or whether every statement of fact contained in the text of the Book can now be made good. It is enough for my present purpose to point to the cosmogony, and the fourfold succession of the living organisms, as entirely harmonizing, according to present knowledge, with belief in a revelation, and as presenting to the rejector of that belief a problem, which demands solution at his hands, and which he has not yet been able to solve. Whether this revelation was conveyed to the ancestors of the whole human race who have at the time or since existed, I do not know, and the Scriptures do not appear to make the affirmation, even if they do not convey certain indications which favor a contrary opinion. Again, whether it contains the whole of the knowledge specially vouchsafed to the parents of the Noachian races, may be very doubtful; though of course great caution must be exercised in regard to the particulars of any primeval tradition not derived from the text of the earliest among the sacred books. I have thus far confined myself to rebutting objections. But I will now add some positive considerations which appear to me to sustain the ancient and, as I am persuaded, impregnable belief of Christians and of Jews concerning the inspiration of the Book. I offer them as one wholly destitute of that kind of knowledge which carries authority, and who speaks derivatively as best he can, after listening to teachers of repute and such as practice rational methods.

I understand the stages of the majestic process described in the Book of Genesis to be in general outline as follows:

1. The point of departure is the formless mass, created by God, out of which the earth was shaped and constituted a thing of individual existence (verses 1, 2).

2. The detachment and collection of light, leaving in darkness as it proceeded the still chaotic mass from which it was detached (verses 3–5). The narrative assigning a space of time to each process appears to show that each was gradual, not instantaneous.

3. The detachment of light from darkness is followed by the detachment of wet from dry, and of solid from liquid, in the firmament, and on the face of the earth. Each of these operations occupies a "day"; and the conditions of vegetable life, as known to us by experience, being now provided, the order of the vegetable kingdom had begun (verses 6–13).

4. Next comes the presentation to us of the heavenly bodies, sun, moon, and stars,

* See Bishop of Winchester's "Commentary."

† This perplexed question is discussed, in a sense adverse to the Septuagint, by the critic of the recent revision, in the "Quarterly Review" for October, No. 222. The revisers of the Old Testament state (Preface, p. vi) that in a few cases of extreme difficulty they have set aside the Masoretic text in favor of a reading from one of the ancient versions.

in their final forms, when the completion of the process of light-collection and concentration in the sun, and the due clearing of the intervening spaces, had enabled the central orb to illuminate us both with direct and with reflected light (verses 14–19).

5. So far, we have been busy only with the adjustment of material agencies. We now arrive at the dawn of animated being; and a great transition seems to be marked as a kind of recommencement of the work, for the name of creation is again introduced. God created—

(*a*) The water-population;

(*b*) The air-population.

And they receive His benediction (verses 20–23).

6. Pursuing this regular progression from the lower to the higher, from the simple to the complex, the text now gives us the work of the sixth "day," which supplies the land-population, air and water having already been supplied. But in it there is a subdivision, and the transition from (*c*) animal to (*d*) man, like the transition from inanimate to animate, is again marked as a great occasion, a kind of recommencement. For this purpose the word "create" is a third time employed. "God created man in His own image," and once more He gave benediction to this the final work of His hands, and endowed our race with its high dominion over what lived and what did not live (verses 24–31).

I do not dwell on the cessation of the Almighty from the creating and (ii, 1) "finishing" work, which is the "rest" and marks the seventh "day," because it introduces another order of considerations. But, glancing back at the narrative which now forms the first chapter, I offer perhaps a prejudiced, and in any case no more than a passing, remark. If we view it as popular narrative, it is singularly vivid, forcible, and effective; if we take it as a poem, it is indeed sublime. No wonder if it became classical and reappeared in the glorious devotions of the Hebrew people,* pursuing, in a great degree, the same order of topics as in the Book of Genesis.

But the question is not here of a lofty poem, or a skillfully constructed narrative: it is whether natural science, in the patient exercise of its high calling to examine facts, finds that the works of God cry out against what we have fondly believed to be His Word, and tell another tale; or whether, in this nineteenth century of Christian progress, it substantially echoes back the majestic sound which, before it existed as a pursuit, went forth into all lands.

First, looking largely at the latter portion of the narrative, which describes the creation of living organisms, and waiving details, on some of which (as in verse 24) the Septuagint seems to vary from the Hebrew, there is a grand fourfold division, set forth in an orderly succession of times as follows: on the fifth day—

1. The water-population;
2. The air-population;

and, on the sixth day,

3. The land-population of animals;
4. The land-population consummated in man.

Now this same fourfold order is understood to have been so affirmed in our time by natural science, that it may be taken as a demonstrated conclusion and established fact. Then, I ask, how came Moses, or, not to cavil on the word, how came the author of the first chapter of Genesis, to know that order, to possess knowledge which natural science has only within the present century for the first time dug out of the bowels of the earth? It is surely impossible to avoid the conclusion, first, that either this writer was gifted with faculties passing all human experience, or else his knowledge was divine. The first branch of the alternative is truly nominal and unreal. We know the sphere within which human inquiry toils. We know the heights to which the intuitions of genius may soar. We know that in certain cases genius anticipates science; as Homer, for example, in his account of the conflict of the four winds in sea-storms. But even in these anticipations, marvelous, and, so to speak, imperial as they are, genius can not escape from one inexorable law. It must have materials of sense or experience to work with, and a ποῦ στῶ from whence to take its flight; and genius can no more tell, apart from some at least of the results at-

* Ps. civ, 2-20, cxxxvi, 5-9, and the Song of the Three Children in verses 57-60.

tained by inquiry, what are the contents of the crust of the earth, than it could square the circle, or annihilate a fact.*

So stands the plea for a revelation of truth from God, a plea only to be met by questioning its possibility; that is, as Dr. Salmon † has observed with great force in a recent work, by suggesting that a Being, able to make man, is unable to communicate with the creature He has made. If, on the other hand, the objector confine himself to a merely negative position, and cast the burden of proof on those who believe in revelation, it is obvious to reply by a reference to the actual constitution of things. Had that constitution been normal or morally undisturbed, it might have been held that revelation as an *adminiculum*, an addition to our natural faculties, would itself have been a disturbance. But the disturbance has in truth been created in the other scale of the balance by departure from the Supreme Will, by the introduction of sin: and revelation, as a special remedy for a special evil, is a contribution toward symmetry, and toward restoration of the original equilibrium.

Thus far only the fourfold succession of living orders has been noticed. But among the persons of very high authority in natural science quoted by Dr. Reusch,‡ who held the general accordance of the Mosaic cosmogony with the results of modern inquiry, are Cuvier and Sir John Herschel. The words of Cuvier show he conceived that "every day" fresh confirmation from the purely human source accrued to the credit of Scripture. And since his day, for he can not now be called a recent authority, this opinion appears to have received some remarkable illustrations.

Half a century ago, Dr. Whewell § discussed, under the name of the nebular hypothesis, that theory of rotation which had been indicated by Herschel, and more largely taught by Laplace, as the probable method through which the solar system has taken its form. Carefully abstaining, at that early date, from a formal judgment on the hypothesis, he appears to discuss it with favor; and he shows that this hypothesis, which assumes "a beginning of the present state of things,"* is in no way adverse to the Mosaic cosmogony. The theory has received marked support from opposite quarters. In the "Vestiges of Creation" it is frankly adopted; the very curious experiment of Professor Plateau is detailed at length on its behalf; † and the author considers, with Laplace, that the zodiacal light, on which Humboldt in his "Kosmos" has dwelt at large, may be a remnant of the luminous atmosphere originally diffused around the sun. Dr. McCaul, in his very able argument on the Mosaic record, quotes ‡ Humboldt, Pfaff, and Mädler—a famous German astronomer—as adhering to it. It appears on the whole to be in possession of the field; and McCaul observes § that, "had it been devised for the express purpose of removing the supposed difficulties of the Mosaic record, it could hardly have been more to the purpose." Even if we conceive, with Dr. Réville, that the "creation," the first gift of separate existences to the planets, is declared to have been subsequent to that of the earth, there seems to be no known law which excludes such a supposition, especially with respect to the larger and more distant of their number. These, it is to be noticed, are of great rarity as compared with the earth. Why should it be declared impossible that they should have taken a longer time in condensation, like in this point to the comets, which still continue in a state of excessive rarity? Want of space forbids me to enter into further explanation; but it requires much more serious efforts and objections than those of Dr. Réville to confute the statement that the extension of knowledge and of inquiry has confirmed the Mosaic record.

* In conversation with Miss Burney ("Diary," i, 576), Johnson, using language which sounds more disparaging than it really is, declares that "Genius is nothing more than knowing the use of tools; but then there must be tools for it to use."

† "Introduction to the New Testament," p. ix. Murray, 1885.

‡ "Bibel und Natur," pp. 2, 63. The words of Cuvier are: "Moyses hat uns eine Kosmogonie hinterlassen, deren Genauigkeit mit jedem Tage in einer bewunderungswürdigern Weise bestätigt ist." The declaration of Sir John Herschel was in 1864.

§ Whewell's "Astronomy and General Physics," 1834, p. 181 *seqq.*

* Whewell, *op. cit.*, p. 206.

† "Vestiges," etc., pp. 11-15.

‡ "Aids to Faith," p. 210. § Ibid.

One word, however, upon the "days" of Genesis. We do not hear the authority of Scripture impeached on the ground that it assigns to the Almighty eyes and ears, hands, arms, and feet; nay, even the emotions of the human being. This being so, I am unable to understand why any disparagement to the credit of the sacred books should ensue because, to describe the order and successive stages of the Divine working, these have been distributed into "days." What was the thing required in order to make this great procession of acts intelligible and impressive? Surely it was to distribute the parts each into some integral division of time, having the character of something complete in itself, of a revolution, or outset and return. There are but three such divisions familiarly known to man. Of these the day was the most familiar to human perceptions; and probably on this account its figurative use is admitted to be found in prophetic texts, as, indeed, it largely pervades ancient and modern speech. Given the object in view, which indeed can hardly be questioned, does it not appear that the "day," more definitely separated than either month or year from what precedes and what follows, was appropriately chosen for the purpose of conveying the idea of development by gradation in the process which the book sets forth?

I now come to the last portion of my task, which is to follow Dr. Réville into his exposition of the Olympian mythology. Not, indeed, the Homeric or Greek religion alone, for he has considered the case of all religions, and disposes of them with equal facility. Of any other system than the Olympian, it would be presumption in me to speak, as I have, beyond this limit, none but the most vague and superficial knowledge. But on the Olympian system in its earliest and least adulterated, namely, its Homeric, development, whether with success or not, I have freely employed a large share of such leisure as more than thirty years of my Parliamentary life, passed in freedom from the calls of office, have supplied. I hope that there is not in Dr. Réville's treatment of other systems that slightness of texture and that facility and rapidity of conclusion which seem to me to mark his performances in the Olympian field.

In the main he follows what is called the solar theory. In his widest view he embraces no more than "the religion of nature" (pp. 94, 100), and he holds that all religion has sprung from the worship of objects visible and sensible.

His first essay is upon Heracles, whom I have found to be one of the most difficult and, so to speak, irreducible characters in the Olympian mythology. In the Tyrian system Heracles, as Melkart, says Dr. Réville in p. 95, is "a brazen god, the devourer of children, the terror of men"; but, without any loss of identity, he becomes in the Greek system "the great lawgiver, the tamer of monsters, the peacemaker, the liberator." I am deeply impressed with the danger that lurks in these summary and easy solutions; and I will offer a few words first on the Greek Heracles generally, next on the Homeric presentation of the character.

Dr. L. Schmidt has contributed to Smith's great Dictionary a large and careful article on Heracles—an article which may almost be called a treatise. Unlike Dr. Réville, to whom the matter is so clear, he finds himself out of his depth in attempting to deal with this highly incongruous character, which meets us at so many points, as a whole. But he perceives in the Heracles of Greece a mixture of fabulous and historic elements; and the mythical basis is not, according to him, a transplanted Melkart, but is essentially Greek.* He refers to Buttmann's "Mythologus" and Müller's "Dorians" as the best treatises on the subject, "both of which regard the hero as a purely Greek character." Thus Dr. Réville appears to be in conflict with the leading authorities, whom he does not combate, but simply ignores.

Homer himself may have felt the difficulty, which Dr. Réville does not feel, for he presents to us, in one and the same passage, a divided Heracles. Whatever of him is not *eidolon*,† dwells among the Olympian gods. This *eidolon*, however, is no mere shade, but something that sees and speaks, that mourns and threatens; no "lawgiver," or "peacemaker," or "liberator," but one from whom the other shades fly in terror, set in the place and company of sinners suf-

* Smith's "Dictionary," ii, 400.

† "Od.," xi, 601-4.

fering for their sins, and presumably himself in the same predicament, as the sense of grief is assigned to him: it is in wailing that he addresses Odysseus.* Accordingly, while on earth, he is *thrasumemnon*,† *huperthumos*,‡ a doer of *megala erga*,§ which with Homer commonly are crimes. He is profane, for he wounded Herè, the specially Achaian goddess; ‖ and he is treacherous, for he killed Iphitos, his host, in order to carry off his horses.¶ A mixed character, no doubt, or he would not have had Hebè for a partner; but those which I have stated are some of the difficulties which Dr. Réville quietly rides over to describe him as lawgiver, peacemaker, and liberator. But I proceed.

Nearly everything, with Dr. Réville, and, indeed, with his school, has to be pressed into the service of the solar theory; and, if the evidence will not bear it, so much the worse for the evidence. Thus Ixion, tortured in the later Greek system on a wheel, which is sometimes represented as a burning wheel, is made (p. 105) to be the sun; the luminary whose splendor and beneficence had rendered him, according to the theory, the center of all Aryan worship. A sorry use to put him to; but let that pass. Now the occasion that supplies an Ixion and a burning wheel available for solarism — a system which prides itself above all things on its exhibiting the primitive state of things — is that Ixion had loved unlawfully the wife of Zeus. And first as to the wheel: We hear of it in Pindar;** but as a winged not a burning wheel. This "solar" feature appears, I believe, nowhere but in the latest and most defaced and adulterated mythology. Next as to the punishment. It is of a more respectable antiquity. But some heed should surely be taken of the fact that the oldest authority upon Ixion is Homer; and that Homer affords no plea for a burning or any other wheel, for, according to him,†† instead of Ixion's loving the wife of Zeus, it was Zeus who loved the wife of Ixion.

Errors, conveyed without testimony in a sentence, commonly require many sentences to confute them. I will not dwell on minor cases, or those purely fanciful; for mere fancies, which may be admired or the reverse, are impalpable to the clutch of argument, and thus are hardly subjects for confutation. *Paulò majora canamus.* I continue to tread the field of Greek mythology, because it is the favorite sporting-ground of the exclusivists of the solar theory.

We are told (p. 80) that because waves with rounded backs may have the appearance (but query) of horses or sheep throwing themselves tumultuously upon one another, therefore "in maritime regions, the god of the liquid element, Poseidon or Neptune, is the breeder, protector, and trainer of horses." Then why is he not also the breeder, protector, and trainer of sheep? They have quite as good a maritime title; according to the fine line of Ariosto:

"Muggendo van per mare i gran montoni."

I am altogether skeptical about these rounded backs of horses, which, more, it seems, than other backs, become conspicuous like a wave. The resemblance, I believe, has commonly been drawn between the horse, as regards his mane, and the foam-tipped waves, which are still sometimes called white horses. But we have here, at best, a case of a great superstructure built upon a slight foundation; when it is attempted, on the groundwork of a mere simile, having reference to a state of sea which in the Mediterranean is not the rule but the rare exception, to frame an explanation of the close, pervading, and almost profound relation of the Homeric Poseidon to the horse. Long and careful investigation has shown me that this is an ethnical relation, and a key to important parts of the ethnography of Homer. But the proof of this proposition would require an essay of itself. I will, therefore, only refer to the reason which leads Dr. Réville to construct this (let me say) castle in the air. It is because he thinks he is accounting hereby for a fact, which would indeed, if established, be a startling one, that the god of the liquid element should also be the god of the horse. We are dealing now especially with the Homeric Poseidon, for it is in Homer that the relation to the horse is developed; and the way to a true explanation is opened when we observe that the

* "Od.," xi, 605–16.
† "Od.," xi, 267.
‡ "Il.," xiv, 250.
§ "Od.," xxi, 26.
‖ "Il.," v, 892.
¶ "Od.," xxi, 26–30.
** "Pyth.," ii, 39.
†† "Il.," xiv, 317.

Homeric Poseidon is *not* the god of the liquid element at all.

The truth is that the Olympian and ruling gods of Homer are not elemental. Some few of them bear the marks of having been elemental in other systems; but, on admission into the Achaian heaven, they are divested of their elemental features. In the case of Poseidon, there is no sign that he ever had these elemental features. The signs are unequivocal that he had been worshiped as supreme, as the Zeus-Poseidon, by certain races and in certain, viz., in far southern, countries. Certainly he has a special relation to the sea. Once, and once only, do we hear of his having a habitation under water.* It is in "Il.," xiii, where he fetches his horses from it, to repair to the Trojan plain. He seems to have been an habitual absentee; the prototype, he might be called, of that ill-starred, ill-favored class. We hear of him in Samothrace, on the Solyman Mountains, as visiting the Ethiopians † who worshiped him, and the reek of whose offerings he preferred at such times to the society of the Olympian gods debating on Hellenic affairs; though, when we are in the zone of the Outer Geography, we find him actually presiding in an Olympian assembly marked with foreign associations.‡ Now compare with this great mundane figure the true elemental gods of Homer: first Okeanos, a venerable figure, who dwells appropriately by the farthest § bound of earth, the bank of the Ocean-river, and who is not summoned ‖ even to the great Olympian assembly of the Twentieth Book; and secondly, the graybeard of the sea, whom only from the patronymic of his Nereid daughters we know to have been called Nereus, and who, when reference is made to him and to his train, is on each occasion ¶ to be found in one and the same place, the deep recesses of the Mediterranean waters. If Dr. Réville still doubts who was for Homer the elemental god of water, let him note the fact that while *neros* is old Greek for *wet*, *nero* is, down to this very day, the people's word for *water*. But, conclusive as are these considerations, their force will be most fully appreciated only by those who have closely observed that Homer's entire theurgic system is resolutely exclusive of Nature-worship, except in its lowest and most colorless orders, and that where he has to deal with a Nature-power of serious pretensions, such as the Water-god would be, he is apt to pursue a method of quiet suppression, by local banishment or otherwise, that space may be left him to play out upon his board the gorgeous and imposing figures of his theanthropic system.

As a surgeon performs the most terrible operation in a few seconds, and with unbroken calm, so does the school of Dr. Réville, at least within the Homeric precinct, marshal, label, and transmute the personages that are found there. In touching on the "log," by which Dr. Réville says Hera was represented for ages, she is quietly described as the "Queen of the shining Heaven" (p. 79). For this assumption, so naïvely made, I am aware of no authority whatever among the Greeks—a somewhat formidable difficulty for others than solarists, as we are dealing with an eminently Greek conception. Euripides, a rather late authority, says,* she dwells among the stars, as all deities might be said, *ex officio*, to do; but gives no indication either of identity or of queenship. Etymology, stoutly disputed, may afford a refuge. Schmidt † refers the name to the Latin *hera;* Curtius ‡ and Preller § to the Sanskrit *svar*, meaning the heaven; and Welcker, ‖ with others, to what appears the more obvious form of Ἔρα, the earth. Dr. Réville, I presume, makes choice of the Sanskrit *svar*. Such etymologies, however, are, though greatly in favor with the solarists, most uncertain guides to Greek interpretation. The effect of trusting to them is that, if a deity has in some foreign or anterior system had a certain place or office, and if this place or office has been altered to suit the exigencies of a composite mythology, the Greek idea is totally misconceived. If we take the pre-name of the Homeric Apollo, we may with some plausi-

* "Il.," xiii, 17–31.
‡ "Od.," viii, 321–66.
‖ "Il.," xx, 7.
† "Od.," i, 25, 26.
§ "Il.," xiv, 201.
¶ "Il.," i, 358; xviii, 36.

* Eurip., "Helena," 109.
† Smith's "Dict.," art. "Hera."
‡ "Griech. Etymol.," p. 119.
§ Preller, "Griech. Mythol.," i, 121.
‖ "Griech. Götterlehre," i, 362–3.

bility say the *Phoibos* of the poet is the Sun; but we are landed at once in the absurd consequence that we have got a Sun already,* and that the two are joint actors in a scene of the eighth *Odyssey*.† Strange, indeed, will be the effect of such a system if applied to our own case at some date in the far-off future; for it will be shown, *inter alia*, that there were no priests, but only presbyters, in any portion of Western Christendom; that our dukes were simply generals leading us in war; that we broke our fast at eight in the evening (for *diner* is but a compression of *déjeuner*); and even, possibly, that one of the noblest and most famous of English houses pursued habitually the humble occupation of a pig-driver.

The character of Hera, or Heré, has received from Homer a full and elaborate development. There is in it absolutely no trace whatever of "the queen of the shining heaven." In the action of the "Odyssey" she has no share at all—a fact absolutely unaccountable if her function was one for which the voyages of that poem give much more scope than is supplied by the "Iliad." The fact is, that there is no queen of heaven in the Achaian system; nor could there be without altering its whole genius. It is a curious incidental fact that, although Homer recognizes to some extent humanity in the stars (I refer to Orion and Leucotheë, both of them foreign personages of the Outer Geography), he never even approximates to a personification of the real queen of heaven, namely, the moon. There happens to be one marked incident of the action of Hera, which stands in rather ludicrous contrast with this lucent queenship. On one of the occasions when, in virtue of her birth and station, she exercises some supreme prerogative, she directs the sun (surely not so to her lord and master) to set, and he reluctantly obeys.‡ Her character has not any pronounced moral elements; it exhibits pride and passion; it is pervaded intensely with policy and nationalism; she is beyond all others the Achaian goddess, and it is sarcastically imputed to her by Zeus that she would cut the Trojans if she could, and eat them without requiring in the first instance any culinary process.* I humbly protest against mauling and disfiguring this work; against what great Walter Scott would, I think, have called "mashackering and misguggling" it, after the manner of Nicol Muschat, when he put an end to his wife Ailie † at the spot afterward marked by his name. Why blur the picture so charged alike with imaginative power and historic meaning, by the violent obtrusion of ideas, which, whatever force they may have had among other peoples or in other systems, it was one of the main purposes of Homer, in his marvelous theurgic work, to expel from all high place in the order of ideas, and from every corner, every loft and every cellar, so to speak, of his Olympian palaces?

If the Hera of Homer is to own a relationship outside the Achaian system, like that of Apollo to the sun, it is undoubtedly with Gaia, the earth, that it can be most easily established. The all-producing function of Gaia in the Theogony of Hesiod ‡ and her marriage with Ouranos, the heaven, who has a partial relation to Zeus, points to Hera as the majestic successor who in the Olympian scheme, as the great mother and guardian of maternity, bore an analogical resemblance to the female head of one or more of the Pelasgian or archaic theogonies that it had deposed.

I have now done with the treatment of details, and I must not quit them without saying that there are some of the chapters, and many of the sentences, of Dr. Réville which appear to me to deserve our thanks. And, much as I differ from him concerning an essential part of the historic basis of religion, I trust that nothing which I have said can appear to impute to him any hostility or indifference to the substance of religion itself.

I make, indeed, no question that the solar theory has a most important place in solving the problems presented by many or some of the Aryan religions; but whether it explains their first inception is a totally different matter. When it is ruthlessly applied, in the teeth of evidence, to them all, in the last resort it stifles facts, and reduces observation and reasoning to a mock-

* See "Infra." † "Od.," viii, 302, 334.
‡ "Il.," xviii, 239, 240.

* "Il.," iv, 35. † "Heart of Midlothian."
‡ "Theog.," 116-136.

ery. Sir George Cox, its able advocate, fastens upon the admission that some one particular method is not available for all the phenomena, and asks, Why not adopt for the Greek system, for the Aryan systems at large, perhaps for a still wider range, "a clear and simple explanation," namely, the solar theory?* The plain answer to the question is, that this must not be done, because, if it is done, we do not follow the facts, nor are led by them; but, to use the remarkable phrase of Æschylus,† we ride them down, we trample them under foot. Mankind has long been too familiar with a race of practitioners, whom courtesy forbids to name, and whose single medicine is alike available to deal with every one of the thousand figures of disease. There are surely many sources to which the old religions are referable. We have solar worship, earth worship, astronomic worship, the worship of animals, the worship of evil powers, the worship of abstractions, the worship of the dead, the foul and polluting worship of bodily organs, so widespread in the world, and especially in the East; last, but not least, I will name terminal worship, the remarkable and most important scheme which grew up, perhaps first on the Nile, in connection with the stones used for marking boundaries, which finds its principal representative in the god Hermes, and which is very largely traced and exhibited in the first volume of the work of M. Dulaure ‡ on ancient religions.

But none of these circumstances discredit or impair the proof that in the Book, of which Genesis is the opening section, there is conveyed special knowledge to meet the special need everywhere so palpable in the state and history of our race. Far indeed am I from asserting that this precious gift, or that any process known to me, disposes of all the problems, either insoluble or unsolved, by which we are surrounded; of

> "the burden and the mystery
> Of all this unintelligible world."

But I own my surprise not only at the fact, but at the manner in which in this day, writers, whose name is Legion, unimpeached in character and abounding in talent, not only put away from them, cast into shadow or into the very gulf of negation itself, the conception of a Deity, an acting and a ruling Deity. Of this belief, which has satisfied the doubts, and wiped away the tears, and found guidance for the footsteps of so many a weary wanderer on earth, which among the best and greatest of our race has been so cherished by those who had it, and so longed and sought for by those who had it not, we might suppose that if at length we had discovered that it was in the light of truth untenable, that the accumulated testimony of man was worthless, and that his wisdom was but folly, yet at least the decencies of mourning would be vouchsafed to this irreparable loss. Instead of this, it is with a joy and exultation that might almost recall the frantic orgies of the Commune, that this, at least at first sight, terrific and overwhelming calamity is accepted, and recorded as a gain. One recent, and, in many ways, respected writer—a woman long wont to unship creed as sailors discharge excess of cargo in a storm, and passing at length into formal atheism—rejoices to find herself on the open, free, and "breezy common of humanity." Another, also woman, and dealing only with the workings and manifestations of God, finds * in the theory of a physical evolution as recently developed by Mr. Darwin, and received with extensive favor, both an emancipation from error and a novelty in kind. She rejoices to think that now at last Darwin "shows life as an harmonious whole, and makes the future stride possible by the past advance." Evolution, that is physical evolution, which alone is in view, may be true (like the solar theory), may be delightful and wonderful, in its right place; but are we really to understand that varieties of animals brought about through domestication, the wasting of organs (for instance, the tails of men) by disuse, that natural selection and the survival of the fittest, all in the physical order, exhibit to us the great *arcanum* of creation, the sum and center of life, so that mind and spirit are dethroned from their old supremacy, and no longer sovereign by right, but

* "Mythology of Aryan Nations," i, 18.

† *καθυπνάζεσθαι*: a remarkable word, as applied to moral subjects, found in the "Eumenides" only.

‡ "Histoire abrégée de différens Cultes." Seconde édition. Paris, 1825.

* I do not quote names, but I refer to a very recent article in one of our monthly periodicals.

may find somewhere by charity a place assigned them, as appendages, perhaps only as excrescences, of the material creation? I contend that Evolution in its highest form has not been a thing heretofore unknown to history, to philosophy, or to theology. I contend that it was before the mind of Saint Paul when he taught that in the fullness of time God sent forth His Son, and of Eusebius, when he wrote the "Preparation for the Gospel," and of Augustine when he composed the "City of God"; and, beautiful and splendid as are the lessons taught by natural objects, they are, for Christendom at least, infinitely beneath the sublime unfolding of the great drama of human action, in which, through long ages, Greece was making ready a language and an intellectual type, and Rome a framework of order and an idea of law, such that in them were to be shaped and fashioned the destinies of a regenerated world. For those who believe that the old foundations are unshaken still, and that the fabric built upon them will look down for ages on the floating wreck of many a modern and boastful theory, it is difficult to see anything but infatuation in the destructive temperament which leads to the notion that to substitute a blind mechanism for the hand of God in the affairs of life is to enlarge the scope of remedial agency; that to dismiss the highest of all inspirations is to elevate the strain of human thought and life; and that each of us is to rejoice that our several units are to be disintegrated at death into "countless millions of organisms"; for such, it seems, is the latest "revelation" delivered from the fragile tripod of a modern Delphi. Assuredly on the minds of those who believe, or else on the minds of those who after this fashion disbelieve, there lies some deep judicial darkness, a darkness that may be felt. While disbelief in the eyes of faith is a sore calamity, this kind of disbelief, which renounces and repudiates with more than satisfaction what is brightest and best in the inheritance of man, is astounding, and might be deemed incredible. Nay, some will say, rather than accept the flimsy and hollow consolations which it makes bold to offer, might we not go back to solar adoration, or, with Goethe, to the hollows of Olympus?

"Wenn die Funke sprüht,
Wenn die Asche glüht,
Eilen wir den alten Göttern zu." *

TRANSLATION.

"When the sparks glitter,
When the ashes glow,
We speed us to the old gods."

Nineteenth Century.

* "Braut von Corinth."

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